The Intelligibility of Speech Addressed to Children

Ellen Gurman Bard

Ph.D.

University of Edinburgh

1982

DECLARATION

I declare that I have composed this thesis and that the work it describes was designed and analyzed by me and carried out by me or under my direction (as described in the acknowledgements).

Abstract

This work responds to a contradiction between the literature on adult speech perception and first language acquisition. It is generally accepted that adults use higher-order linguistic information in recognizing words in running speech (Marslen-Wilson and Tyler, 1980) because they must: when isolated from their sentence contexts, taped words are quite unintelligible (averaging 50%; Pollack and Pickett, 1963). Children acquiring their language must lack much of the knowledge of syntax, semantics, *etc.*, which makes adult speech perception possible. Yet, adult judgements of the clarity of whole maternal sentences (Broen, 1972; Remick, 1976; Newport *et al.*, 1978) are taken to imply that children should be able to recognize and use all the speech addressed to them. It seems more likely that young children should be nearly as handicapped as Pollack and Pickett's subjects who were forced to recognize words from their accoustic shape alone. This dissertation attempts to determine whether children might avoid that handicap either through the clarity of parental speech or through special perceptual characteristics of their own: the results suggest that neither factor is particularly helpful to the child.

The experimental work used a corpus of spontaneous speech by both parents of one girl and one boy in each of three age ranges (22-24, 28-30, 34-36 months). In some experiments, words electronically segmented from running speech to the child or to the Experimenter were presented to adults or to three-year olds for identification. In others, the source sentences for those same words, or the sources without the crucial words were used.

The principle finding is that words originally addressed to children were

less intelligible for adult listeners than words to the adult (25 vs 42%; min F' at p <.05). Further experiments and multiple regression analysis showed that the decreased intelligibility was associated with three feature of parental speech which might otherwise be thought of as simplifying the input, -- the use of short words, words predictable from their surrounding sentence and words referring to present objects. Each feature correlates negatively with intelligibility.

Furthermore, children listening to segmented object names showed no special tatent for recognizing words from accoustic shapes alone and no consistent preference for parentese stimuli. They were, however, able to profit from extra-linguistic information, for recognition scores rose when the named objects were visible.

The results are discussed with referrence to adult-child speech and children's use of it. It is proposed that adults cannot adjust word intelligibility independently of redundancy, *etc.* because they assess the clarity of their own speech by integrating linguistic information as they do in perceiving others' speech. As a result, children may have to rely on extra-liguistic information and on the occasional clear words in parentese both to appear to understand adults and to learn more about their language.

ACKNOWLEDGEMENTS

The work reported in this dissertation was supported by SSRC Project Grant Number HR 6130 to Dr. John Laver and myself. The planning of the research, the design of the experiments and their analyses were my own work. Most of the experiments and some of their statistical analyses were run by Anne Anderson, Research Associate in the Project. I am indebted to her not only for her considerable intellectual contributions to the work, but also for her devotion to her occasionally very tedious duties.

I am grateful to Dr. Laver for his part in making the work possible and for his labors as my supervisor. His steadfast support and encouragement have been invaluable. I thank Dr. Tom Pitcairn for cheerfully executing the lengthy supervision of my dissertation and for repeatedly making molehills out of mountains. Thanks are also due to Dr. John Marshall, who oversaw the earliest stages of this work and had the grace to remain interested throughout its long course.

The research itself would have been impossible without the goodwill of individuals who arranged access to the informants and subjects that we needed. Dr. Tom Bower generously allowed us the run of his sample of charming and helpful families with small children. Professor Margaret Donaldson-Salter not only assured easy access to the children in the Psychology Department Nursery, but also took the time to discuss the techniques and results of the work. Mr. J. Timmins of the Lothian Regional Council Education Department helped us to find suitable nursery schools and classes. I am grateful to them as I am to the speakers who produced our corpus and to the adults and children who tried to listen to selections from it.

I also owe debts of gratitude to the many people who have helped with various aspects of the research: to Mr. Peter Fisk for painstaking attention to our statistical queries, to Ms. Irene McLeod, Mr. Norman Dryden, and Mr. Jim Piper for assistance with computing, to Ms. Ethel Jack and Ms. Adrienne Terris for typing, and to my colleagues and students for forebearance. Particular thanks go to Ms. Frances Macnamara, the Clerical Assistant on the Project, for performing more duties than the job description ever encompassed.

I am unable to find adequate words to thank my husband, Jonathan Bard, for his patience over all these years and for his help with just about everything: his price is above rubies.

In any undertaking as lengthy as this research proved to be, there is always some one without whose help it would have been finished a good deal sooner. This honor goes to Adam Zachary Bard. Thanks, kid.

TABLE OF CONTENTS

-----	CHAPTER ONE: The Problem	1
	Footnote	5
-----	CHAPTER TWO: The Literature	6
I.	Introduction	6
II.	Intelligibility	6
II.A.	Some physical parameters	7
II.B.	Some Ways of Reducing the choices available	9
III.	Speech Processing in Children	13
III.A.	Is Phonological Development an Aid to Speech Perception?	14
III.B.	Does the Young Child Process Sentences like an Adult?	16
III.C.	What Help can be Found in Extralinguistic Context?	20
III.C.1.	The Development of Word Meaning	21
III.C.2.	Sentence Processing	23
IV.	Parental Speech as an Aid to Language Acqisition	28
IV.A.	Speech to Children vs. Speech to Adults	30
IV.A.1.	Addressee Differences in Mother's Speech	31
IV.A.1.a.	Physical and Accoustic Variables	32
IV.A.1.b.	Amount of Speech	39
IV.A.1.c.	Measures of Syntactic Complexity	39
IV.A.1.d.	Other Possible Sources of Psycholinguistic Complexity	43
IV.A.1.e.	Uses of Form Classes	48
IV.A.1.f.	Measures of Redundancy	53
IV.A.1.g.	Specific Language Exercises	56
IV.A.2	The Universality of Adult-Child Speech	57
IV.A.2.a.	The Speech of Others to Children	57
IV.A.2.b.	Adult-Child Speech Across Culture and Social Class	61
IV.B.	The Effect of the Child's Language Development	63
IV.B.1	The Simple Correlations with Age and Language Development	63
IV.B.1.a.	Physical Variables	65
IV.B.1.b.	Amount of Speech	65
IV.B.1.c.	Measures of Syntactic Complexity	67
IV.B.1.d.	Other Possible Sources of Psycholinguistic Complexity	70
IV.B.1.e.	Use of Form Classes	72
IV.B.1.f.	Measures of Redundancy	73
IV.B.1.g.	Specific Language Exercises	76
IV.B.2.	Other Elicitors of Adult-Child Speech	76
IV.C.	Attempts to Find Effects of Adult-Child Speech on Language Development	78
IV.C.1.	Deprivation Studies	78
IV.C.2.	Intervention Studies	80
IV.C.3.	Observational studies	82
IV.C.3.a.	Measures of Syntactic Complexity	86
IV.C.3.b.	Use of Form Classes	87

IV.C.3.c	Measure of Psycholinguistic Complexity	87
IV.C.3.d.	Measures of Redundancy	89
IV.C.3.e.	An Incoherent Picture	91
IV.D.	Motherese-Shmotherese	93
IV.D.1.	A Cold Look at a Warm Register	93
IV.D..2.	The Intelligibility of Parentese	99
	Footnotes	100
-----	CHAPTER THREE: Experiments with Adult Subjects	104
I.	Designing the Corpus and Establishing Initial Hypotheses	104
I.A.	Informants	106
I.B.	Corpus Collection	106
I.C.	Transcription	108
II.	The Initial Choice of Subjects	108
III.	Experiment 1: Random Words in Isolation	109
III.A.	Purpose	109
III.B.	Method	110
III.B.1.	Materials	110
III.B.2.	Design	111
III.B.3.	Subjects	111
III.B.4.	Procedure	112
III.C.	Results	112
III.C.1.	Scoring	
III.C.2.	Statistical Methods	112
III.C.3.	The Findings	116
III.C.3.a.	Addressee	116
III.C.3.b.	Parent Sex	117
III.C.3.c.	Child Sex	117
III.C.3.d.	Child Age	119
III.D.	Discussion	121
III.D.1.	The Addressee Effect	121
III.D.2.	The Child Age Effect	124
III.D.3.	Child Sex	127
III.D.4.	Parent Sex	129
IV.	Experment 2: Matched Words in Isolation	130
IV.A.	Purpose	131
IV.B.	Method	131
IV.B.1.	Materials	131
IV.B.2.	Design	132
IV.B.3.	Subjects and Procedure	132
IV.C.	Results	132
IV.C.1.	Scoring	132
IV.C.2.	Statistical Method	132
IV.C.3.	Findings	134
IV.D.	Discussion	134
V.	Experiment 3: Words in Context	138
V.A.	Purpose	138
V.B.	Method	138
V.B.1.	Materials	138
V.B.2.	Design	139
V.B.3.	Subjects and Procedure	139
V.C.	Results	139

V.C.1.	Scoring	139
V.C.2.	Statistical Analysis	142
V.C.3.	Findings	142
V.D.	Discussion	143
VI.	Experiment 4: Redundancy in Context	145
VI.A.	Background and Purpose	145
VI.B.	Method	146
VI.B.1.	Materials	146
VI.B.2	Design	146
VI.B.3.	Subjects	146
VI.B.4.	Procedures	147
VI.C.	Results	147
VI.D.	Discussion	149
VII.	General Discussion	156
	Footnotes	156

-----	CHAPTER FOUR: Experiments with Child Subjects	158
I.	Introduction	158
II.	Pilot Studies	160
II.A.	Choosing a Method	160
II.A.1.	The Task	160
II.A.2.	The Child Subjects	161
II.B.	Experiment 5: Words of Known Intelligibility to Adults	162
II.B.1.	Purpose	162
II.B.2.	Method	162
II.B.2.a.	Materials, Design, and Subjects	162
II.B.2.b.	Procedures and Apparatus	163
II.B.3.	Results and Discussion	167
III.	Experiment 6: Matched Words	166
II.C.1.	Purpose	166
II.C.2.	Method	166
II.C.3.	Results and Discussion	167
III.	Experiment 7: The Effects of Addressee and Context for Child and Adult Subjects	168
III.A.	Purpose	168
III.B.	Method	169
III.B.1.	Materials	169
III.B.2.	Design	170
III.B.3.	Subjects	171
III.B.3.a.	Children	171
III.B.3.b.	Adults	171
III.B.4.	Procedure	172
III.B.4.a.	Children	172
III.B.4.b.	Adults	173
III.C.	Results	173
III.C.1.	Scoring	173
III.C.2.	Contrasting Citation and Conversational forms	173
III.C.3.	Effects within Conversational Forms	175
III.C.3.a.	Initial Analyses	175
III.C.3.b.	Subsequent Analyses	182
III.D.	Discussion	198

IV	Experiment 8: Redundancy	202
IV.A.	Background	202
IV.B.	Method	202
IV.B.1.	Materials and Design	202
IV.B.2.	Subjects and Procedure	203
IV.C.	Results	203
IV.C.1.	Scoring	203
IV.C.2.	Analysis	204
IV.D.	Discussion	207
V.	Experiment 9: Age of Acquisition	210
V.A.	Background and Purpose	210
V.B.	Method	212
V.B.1.	Materials and Procedure	212
V.B.2.	Subjects	212
V.C.	Results and Discussion	212
VI.	General Discussion	213
	Footnotes	216
-----	CHAPTER FIVE: Stimulus Variables	218
I.	Introduction: Unfinished Business	218
II.	Method	220
II.A.	Independent Variables	220
II.A.1.	Corpus Variables	220
II.A.2.	Type Variables	220
II.A.3.	Token Variables	223
II.A.4.	An Experimental Variable	224
II.B.	Statistical Methods	224
II.B.1.	General Procedure	224
II.B.2.	The Set-Hierarchical Approach	226
III.	Experiments 1 and 2	230
III.A.	Set-Hierarchical Analysis	230
III.A.1.	Overall Analysis	230
III.A.2.	Effects of Grouping	234
III.B.	Relationships among Independent Variables	237
III.C.	Correlations with Addressee	240
III.D.	Summary	242
IV.	Experiment 7	242
IV.A.	Adult Subjects	242
IV.A.1.	Set-Hierarchical Analysis	242
IV.A.1.a.	Overall Analysis	242
IV.A.1.b.	Effects of Grouping	243
IV.A.2.	Relationships among Independent Variables	243
IV.A.2.a.	Duration	243
IV.A.2.b.	Context	246
IV.A.2.c.	Age of Acquisition and Frequency of Occurrence	246
IV.A.3.	Correlations with Addressee	249
IV.B.	Child Subjects	252
IV.B.1.	Set-Hierarchical Multiple Regressions	252
IV.B.1.a.	Overall Analysis	252
IV.B.1.b.	Effects of Grouping	253
IV.B.2.	Relationships among Variables	254
IV.B.2.a.	Duration	254

IV.B.2.b.	Context	256
IV.B.2.c.	Frequency and Age of Acquisition	261
IV.B.3.	Correlations with Addressee	261
IV.C.	Summary	262
V.	Conclusions	265
	Footnotes	267
-----	CHAPTER SIX: Conclusions	269
I.	Summary	269
I.A.	The Intelligibility Hypothesis	269
I.B.	The Perception Hypothesis	275
II.	Implications	279
	Footnotes	284
-----	BIBLIOGRAPHY	285
-----	APPENDICES	304

CHAPTER ONE: The Problem

The work to be reported here was inspired by a contradiction between current views of adult speech perception and first language acquisition. Recent approaches to adult recognition of spoken language are colored by a fact first demonstrated by Pollack and Pickett in 1963. These experimenters found that single word tokens[1] artificially isolated from their contexts in surreptitiously recorded conversations are very difficult to identify (averaging about 50% correct) while those same taped words within their original sentence contexts were transcribed at least as easily as words pronounced in isolation usually are (85-100% correct). This finding formed one of the cornerstones of the generally accepted view that adults do not perceive each word on the basis of its sound alone (i.e. 'bottom-up'), but rather that they use their 'higher order' knowledge of the syntactic, semantic and lexical regularities of their language in order to determine which words the otherwise ambiguous acoustic shapes must represent. Considerable attention has been given to the ways in which various sorts of linguistic information interact to achieve speech perception (see Reddy, 1980; Cole and Jakimik, 1980; Marslen-Wilson and Tyler, 1980) but all the current approaches assume that we have to know a great deal about how our language works to know what we think we hear.

Children who are only acquiring their language, on the other hand, are assumed to know very little about how it works. To the extent that they do not have access to the sorts of linguistic information employed by adults in speech perception, they must be in a position analogous to that of Pollack and Pickett's Subjects. The acoustic shapes of words are available to both groups but, either because they are largely unusable or because they have been excised from the tape, the linguistic contexts are not. The implication is clear: insofar as words produced in normal speech are not particularly intelligible, young children should have a great deal of difficulty in recognizing what is said to them.

Nonetheless, theories of first language acquisition usually assume that children's word recognition is so automatic and so accurate that linguistic knowledge can be acquired via the speech perception of the linguistically naive listener. Word tokens are supposed to be segmented from the speech stream and given a phonological analysis which will allow them to be identified and reproduced as instances of some real or spurious lexical item (Ferguson and Farwell, 1975; Vihman, 1978) and ultimately this process is supposed to provide the child with enough information to infer the phonological oppositions of his language. Or the cooccurrence of familiar and novel morphs, each correctly identified, is to be observed repeatedly by the child until he draws unconscious conclusions about their distributions (Slobin, 1973; Clark and Clark, 1977). Or recognized word tokens are associated with aspects of the extra-linguistic environment which give rise to the words' meanings (Nelson, 1977; Clark, 1980; Bowerman, 1977). Indeed the literature on the child's linguistic input seems to be founded on the notion that its character as a distal stimulus, -- as it is said -- , is indistinguishable from its character as a proximal stimulus, -- as it is perceived by the child. It is by no means unreasonable that acquisition theories should depend on the child's observation of his linguistic environment: it is difficult to imagine any other approach. But if word or morph recognition is a relatively unlikely event for the linguistic novice, then our theories will have to be adjusted accordingly.

It may be possible to preserve the theories intact if we can show that what we will call the Pollack and Pickett effect does not apply here. There are at least two classes of ways in which the effect could be neutralized.

Speech that is addressed to small children might simply be clearer word-for-word than speech to adults. The literature does suggest that 'motherese' might show a very small Pollack and Pickett effect. Mothers' speech to their children is easier to transcribe than their speech to adults (Broen, 1972; Remick, 1971; Newport, Gleitman, and Gleitman, 1977) and in the delivery of written instructions, it contains a larger number of slowly articulated or stressed syllables (Garnica, 1977). If adults can adjust their articulatory habits to the perceptual limitations of their young listeners, then the difficulties we have foreseen will simply never arise. For the sake of convenience we can use the term *Intelligibility Hypothesis* to label the proposal that adult-child speech is particularly clear.

Alternatively, the child might be rescued by his own perceptual capacities. He might be impervious to the differences between the pronunciation of a word in isolation, which most adults could recognize, and its rendition in context, which many could not. As a child of one or two has a fairly tenuous grasp of his language's phonological system, he might be insensitive to differences in pronunciation which adults find very noticeable. Or the child's perceptual bent might be so well matched by the articulatory or intonational characteristics of parental speech that regardless of its intelligibility to adult listeners, parentese provides him with effectively undegraded word tokens. Or a child who displays a very immature command of language in his speech may yet be able to turn in processing to one or another of the 'higher order knowledge sources' explored in the adult literature. Or he may rely on extra-linguistic information to help him determine what objects, events, or situations could be under discussion. Any of these possibilities might be described as a *Perception Hypothesis*.

This dissertation was designed to test these two rather general hypotheses. Chapter Two begins the process by reviewing several areas of literature to quite different depths and purposes. The literature on the intelligibility of individual words is summarized to set the boundaries of the experimental problem. Recent work on children's processing of spoken language is sampled to assesss the likelihood that a version of the Perception Hypothesis will yield a cure for the Pollack and Pickett effect. Finally the literature on adult speech to children is examined in detail in order to evaluate the proposal that the child's linguistic input generally acts as a *deus ex machina* to reduce the apparent difficulty of acquiring a first language by observation. None of these areas offers any clear evidence that the Pollack and Pickett effect will not be an issue for young children.

Accordingly, Chapter Three proceeds to the experimental exploration of the Intelligibility Hypothesis. It describes the corpus of parents' spontaneous speech which provided all the materials used throughout the research and reports the results of four experiments. These first test the relative intelligibility, for adult listeners, of words originally spoken to children or to adults, excised from their linguistic contexts, and presented in isolation in a manner analogous to the techniques used by Pollack and Pickett themselves (Experiments 1 and 2). Then the intelligibility of the same words within their original contexts is established (Experiment 3) and an explanation is offered for the results in terms of a well-attested characteristic of motherese (Experiment 4). To examine several of the variants of the Perception Hypothesis, Chapter Four describes the development of a method for assessing the intelligibility to child listeners of single word stimuli excerpted from spontaneous speech. It reports three experiments which used children (Experiments 5-6) or children and adults (Experiment 7) as subjects and two more (Experiments 8-9) attempting to link results on the child task with the findings reported for adults. Chapter Five employs multiple regression analysis to explore the characteristics of individual stimulus words which are associated with intelligibility as measured in Experiments 1, 2, and 7, and it provides a means of describing what makes words intelligible to adults and young children.

Finally, Chapter Six takes up the burden of adjusting our views of parental speech and children's speech perception to accommodate the experimental and statistical results. Some adjustment is certainly in order, for the work reported here has the worst possible implications for the Intelligibility Hypothesis and offers only modest alleviation of the Pollack and Pickett effect via a perceptual strategy available to the child.

Footnote

1. I will maintain the distinction between *word types*, which are word forms or distinct spellings, and *word tokens* which are uttered or written instances of the word types. (That last sentence contained two tokens of the type 'types'.) *Lexical items* or dictionary entries may subsume one or more different types or word forms. ('Type' and 'types' belong to the lexical item TYPE.) Often I will use 'lexical item' and 'word type' interchangeably because the distinction is not relevant to many of the stimuli I have used and because the rules for relating lexical items to their various word forms or types are not at issue here.

CHAPTER TWO: The Literature

I. Introduction

In our search for ways in which young children and our theories about their language acquisition might be protected against the detrimental effects of adults' unintelligible speech, we will need to look at several different areas of the literature. First, and briefly, we will summarize the findings on the intelligibility of single words so that we can ascertain what it is about the signal of the perceiver that should enable the latter to identify the former. Next we will survey the literature on children's speech perception and sentence processing, -- on the understanding that these are inseparable -- in an attempt to discover processing abilities which might compensate for the vagaries of the speech wave form. Finally, and at some length, we will explore the behavior which is the primary object of study in the chapters which follow, -- speech addressed to children. Here we ask whether there is already any evidence that adult-child speech is more intelligible than adult-adult speech and whether, in general, adult-child speech is the *deus ex machina* for the mysterious process of first language acquisition.

II. Intelligibility

Studies of the intelligibility of single words date largely from the period when psychologists were not yet convinced that speech was anything but a set of isolated words strung end to end. Consequently most studies in this section deal with what can be called *citation forms* of words, forms pronounced in isolation or as read from a list of unrelated items. A few use words from sentences read aloud and one only deals with spontaneous speech. While the applicability of most of the findings to conversational speech may be doubtful, it is at least worthwhile to enumerate the correlates of word intelligibility in these studies so that we may later ascertain which of them do apply in the more natural stimuli of present research.

Before we do this, some definition must be given of the word *intelligibility*. *Intelligibility* (in some cases, *recognition score* or *articulation score*) is usually taken to be the percent of attempts to identify a stimulus or class of stimuli which are correct. It is probably worth recalling that since some of the early studies gave more attention to sampling words than to sampling listeners, a score of 50% might mean that one listener identified all the words in a cell while the other was deaf, or that each got as many words as he missed. It is also worth keeping in mind that the great clarity of citation forms and the practical goals of these studies within communications engineering demanded that noise be artificially introduced along with the stimulus to test intelligibility at various signal-to-noise (S/N) ratios. As we will see in Chapter Three, there is no need to add noise to words taken from spontaneous speech.

II.A. Some Physical Parameters

Length. One very simple correlate of intelligibility is stimulus length. Rubenstein, Decker, and Pollack (1959), who measured word length in syllables, found that longer words could be recognized at lower signal-to- noise ratios regardless of the familiarity of the set of stimuli. Pickett and Pollack (1963), who examined single-word excerpts from paragraphs read aloud at different speeds (3-4, 4.4-5.5, or 6.2-7.7 syllables/second), found that at any given speed the longer stimuli were more intelligible. By manipulating the duration of these same stimuli artificially, Pickett and Pollack determined that it was not so much the time over which a stimulus was spread as its acoustic contents that led to this result. One more precaution was taken by Rosenzweig and Postman (1958). As the less frequent words of a language tend to have the greater letter length (Zipf, 1965), Rosenzweig and Postman had to demonstrate that the length effect was something more than a preference for rare words. In fact, in each word frequency band, longer words were the more intelligible.

Speech Rate. Pickett and Pollack's (1963) study also showed that the same single words were more intelligible at the slower rates. Again as artificial rate decrease also decreased intelligibility, slower natural speech like greater natural word length, helps the listener by adding acoustic detail. Similarly, Tolhurst (1957) presented lists of words which had been recorded at three speeds. The stimuli at the slowest speed proved easiest to identify.

Of particular interest here is Berry and Erickson's (1973) finding that kindergarten and second grade children (ages 4-5 and 6-7), showed more comprehension on the Northwest Syntax Screening Test sentences when they were presented at slower than normal speed (normal here defined at about five syll/sec). Whether the slow speech allowed them more processing time or whether it reduced the processing burden by yielding more intelligible word tokens is, of course, not clear.

Visual Information. Not all the cues to the sounds being produced come from the acoustic signal. Erber (1975) reviews a number of studies on normal and hearing-impaired Subjects, which show that both groups produce more correct word identifications when they can see the speaker's face. But as the gain from visual information reduces as the S/N ratio rises to 0dB, the speakers facial movements may only be an aid in times of acoustic trouble. The use of visual information in segment identification is stresed by Mac-

Donald and McGurk (1978) whose technique of presenting conflicting visual and auditory information is not entirely naturalistic. Still, all these findings give new impact to the term 'face-to-face interaction'.

II.B. Some Ways of Reducing the Choices Available

The other correlates of word intelligibility seem to function as means for eliminating parts of the lexicon from consideration as identities for the stimulus, and each of them can be seen as providing a context in which some words are more likely to occur and, *ceteris paribus*, be easier to recognize than others.

Frequency of Occurrence. The most obvious of these parameters, frequency of occurrence as measured in word frequency counts (Thorndike and Lorge, 1944; Kučera and Francis, 1967), appears to be the default context. Pollack, Rubenstein, and Decker (1959) presented the same lists of citation form stimuli twice to the same listeners under the same conditions and found that the words with higher frequency ratings were more intelligible only on the first presentation. On the second presentation, they argued, the set of stimuli was already known to the Subjects and replaced *a priori* likelihood of occurrence as a means of limiting possible word identities.

Though word frequency may only be a last resort, its importance in these tasks should not be underestimated. Lists of common words proved more resistant to intelligibility loss when low-pass filtered than similar lists of rarer words (Epstein, Giolas, and Owens, 1968). For each ten fold increase in frequency of occurrence, stimuli could withstand a 3-4dB drop in S/N ratio without becoming noticeably less intelligible (Howes, 1957). And for lists of English monosyllables and French disyllables, 60% of the variance in the threshold S/N ratio was associated with the log of the word's frequency occurrence.

Category Name and Word Association. Once a listener is told what lexical field the stimulus will belong to (eg plants, colors, etc.), he has a better chance of recognizing the word. Leventhal (1973a) showed that this effect worked only if the category name preceded the stimulus: after a listener had heard the stimulus, the semantic restriction was ineffective. And Rubenstein and Pollack (1963) demonstrated that the use of category names creates a new set of choices, within which the more predicable members of the set (the more frequent in category norms) can be recognized at lower S/N ratios.

In the same experiment Rubenstein and Pollack (1963) presented single word stimuli after cue words to which the target stimuli were responses of known ranking in word association norms. Subjects both predicted and reported the target and were more successful at reporting the higher-ranking associates. As word association is largely paradigmatic in adults, this task differs from the category name task only in using a co-hyponym rather than a superordinate term to delimit a lexical field.

Most Frequent Error. Traul and Black (1965) presented words of known low intelligibility after the word which was known to be the most frequent incorrect identification for the stimulus and warned Subjects of the danger of misidentification. While this condition raised intelligibility above the control baseline, mere repitition of the stimulus did not. Thus the word list was originally unintelligible not because listeners failed to perceive the acoustic signal but because they made incorrect decisions about the 'nearest' English word.

Sentence Context. More directly relevant to the problems of ordinary speech perception is the finding that words are better recognized in sentences than in isolation. The original finding, by Miller, Heise, and Lichten (1951) showed only that sentence contexts were a way of reducing the number of alternatives in the set of possible responses, which in turn determines resistance to low S/N ratio. Miller *et al.* did not think it necessary to present the same recorded word token with and without linguistic contexts. Similarly Leventhal (1973a) found not that words presented first or last in a sentence were more intelligible than other tokens of the same word, but than other words from the same frequency range presented in isolation.

A more convincing account of the phenomenon comes from Pollack and Pickett (1963) who surreptitiously recorded conversationss between an accomplice and each of four Subjects who were led to believe that they were waiting for the experimental apparatus to be repaired. Samples of four to fifteen sequential words which were clear to the transcribers of the conversations were copied and presented cumulatively, first the first word of a sample alone, then the first two, etc. The single words were least intelligible, with the one-word scores ranging from 20%-97% with a mean of about 50%. Intelligibility rose with stimulus length but not monotonically. This last finding is not surprising: a string of words is not most appropriately described by length in words but rather by semantic-syntactic units which can be of any word length.

McGarr (1981) performed a similar experiment on word tokens in sentences read aloud by children aged 8-10 and 13-15 years. Single words excised from these readings were less intelligible to adult listeners than the same taped tokens in their sentence contexts.

As one might expect from our discussion of word frequency and lexical field effects, the predictability of a word within its sentence context was found to affect its intelligibility when presented in that string (Rubenstein and Pollack, 1963). These authors state that the word's intelligibility in isolation is independent of its predictability. It is not clear, however, that the same recordings of the words were used in both cases or even that the in-sentence version (actually end-of-sentence here) was recorded with the rest of the context sentence.

The distinctions become crucial when we consider Lieberman's (1963) results. Three speakers recorded pairs of sentences which included the same target words but differed in the target's predictability as judged by adults' success at supplying the word when given its left or total sentence context. Although all sentences were perfectly intelligible, the overall intelligibility for the predictable tokens when isolated was less (26.06%) than for the unpredictable (57.16%; $t=3.17$, $df=36$, $p<.01$, two-tailed)[1]. Lieberman points out that the predictability of a word token in context and its intelligibility in isolation are 'inversely proportional'. The negative correlations between intelligibilty and contextual redundancy ($r=-.172$ for left and $-.293$ for total context) do not actually approach significance at .05 but the small sample size ($N=14$) may be largely to blame.

In contrast, McGarr found that words spoken by hearing and deaf children in sentence contexts where they were highly redundant were *more* intelligible than other tokens of the same words in less redundant contexts. It is not obvious why this reversal should appear, unless the stimulus materials were so difficult for the young readers that they could only produce confidently clear renditions of those sentences whose high redundancy brought them within their processing capacities.

If Lieberman's finding does hold for spontaneous speech, it gives us reason to disassociate the study of individual word tokens from studies of word or error detection in sentences or texts (for example, Marslen-Wilson and Tyler, 1980; Cole and Jakimik, 1980). What the word token itself offers to the listener will be obscured in these studies, for just those sorts of contextual information which will boost processing accuracy may encourage the speaker to produce less acoustically helpful tokens. What appears to be clear speech may therefore be no more than an extremely redundant string of highly unclear word tokens. The question we must ask is whether the redundancy which we can use in normal speech recognition is available to the child listener or whether he is forced to face the physical signals unaided.

III. Speech Processing in Children

If the sorts of speech which children are likely to hear are not of markedly better acoustic quality than Pollack and Pickett's sample, we would do well to look for perceptual abilities in children which are capable of overcoming the degraded speech signal. In this section we will consider three suggestions as to what these might be. First, a young child's appreciation of his language's phonological system may be so slight that he overcomes acoustic vagaries by overlooking them: a listener who fails to distinguish among /l/, /r/, and /w/ may not be worried by an unrounded initial segment in a token of *well* or a rendition of its final segment as an approximant. We can consider this possibility with brief reference to work on phonological development. Alternatively the language acquiring child may have access to sources of linguistic information for which we have not yet given him credit. We will look for these in attempts to find adult-like language processing in children. Finally, the child's demonstrable predilection for attending to extra-linguistic concomitants of linguistic tasks may supply him with a source of knowledge which will substitute for the syntactic and lexical information which adults use in processing. We will therefore consider the role of extra-linguistic context both in lexical development and in sentence processing.

III.A. Is Phonological Underdevelopment an Aid to Speech Perception?

The simple answer to this question must be 'no'. Consider what a helpful state of phonological ignorance would involve. First the child must lack certain phonological distinctions or at least permit allophonic realizations of some phonemes which for adults would either belong to another phoneme of the language or to none at all. Then the child must not lack too many distinctions: his permissiveness must stop exactly where the disorder of adult articulation stops. Otherwise he could conflate accurate renditions of different lexical items into a single phonologically vague word shape. In fact, it would be useful if the child could do without some of the articulatory cues due to segment distinctions so that he could make the proper ~~cues~~ distinctions on the basis of the incomplete information supplied by adult speakers. It is fairly plain that young children's command of phonology does not meet these conditions.

The younger child may lack distinctions which would make poorly articulated words confusing: the /l/, /w/, /r/ distinction mentioned above is one example. The voiced/voiceless distinction is another. But these distinctions separate phonemes in English and a child who is undisturbed by a rendering of *well* as something close to /rɛw/ should also be unable to separate *rake*, *lake*, and *wake*. And a child who can recognize something akin to /dəp/ as 'top' should confuse 'tip' with 'dip'.

But such confusions are often cited. Vihman (1981), for example, notes her son's phonological conflations of words which are readily distinguishable to adult ears. And the inability of many two- and three-year-olds to make the phonetic distinctions (see Edwards, 1974; Strange and Broen, 1981, for examples) is also well attested. So far from being only 'sufficiently incompetent', young children may be excessively incompetent at many perceptual tasks.

Furthermore, when they can make perceptual distinctions, young listeners may require more, not less acoustic information than adults. Greenlee (1980) found that, unlike adults, three-year-olds could not make a voicing distinction for word-final consonants on the basis of the duration of the preceding vowel. They required the additional cue present in the voicing of the segment itself, a cue often absent in adult and child speech.

To make matters still worse, it is not clear that children acquiring phonological distinctions can perceive them wherever their cues occur. While a considerable body of evidence argues that children acquire lexical items because they can pronounce them (Schwarz and Leonard, 1982; Ferguson & Farwell, 1975; Drachman, 1973b; Macken, 1976; Celce-Murcia, 1978), Barton (1976) showed that two-year-olds had perceptual command of certain one-distinctive feature oppositions only in words they knew well. If the distinctions could not be made for unfamiliar words, one wonders how the forms of the familiar ones were acquired in the first place. Perhaps we should concur with Ferguson and Farwell's (1975) proposal that lexical and phonological development are mutually dependent. If this is so, it is still unclear both how items requiring novel contrasts enter the child's lexicon and how the perception of novel items, for which he should often be unable to make old contrasts, is accomplished. Since children's phonological inabilities do not meet the specifications of a useful perceptual filter and since phonological and lexical development play chicken and egg, it does not seem likely that the cure for acoustic degeneracy in speech lies in children's grasp of a sound system.

III.B. Does the Young Child Process Sentences like the Adult?

Since the work of Marslen-Wilson and his associates (Marslen-Wilson, 1973, 1975; Marslen-Wilson and Welsh, 1978; Marslen-Wilson and Tyler, 1980) has firmly implicated both syntactic and semantic information in the recognition of word forms and word meanings in speech, the question we wish to ask here is whether children whose linguistic output is still quite semantically and syntactically deficient can nonetheless manage the intricate interaction of these sorts of information which enables adults to process speech. Again the simple answer is probably 'no'.

Part of the difficulty here, however, is that children under four or five will seldom perform the intricate tasks from which the interplay of linguistic knowledge sources is discerned. For instance, three-year-olds did not do sufficiently well in Cole and Perfetti's (1980) error-detection task (see below) to pass the practice session and even five-year-olds often refused to monitor for words of a pre-announced category in Tyler and Marslen-Wilson (1981). Whether these refusals mark psycholinguistic inability or an incapacity for concentrated mental effort is open to question.

For children who could perform the tasks, we find a use of linguistic structure analogous to adults' but not without room for improvement. As Subjects' response patterns typically show development from age four onwards, we would be unwise to assume that the results for elementary school children would be replicated for toddlers or preschoolers.

For instance, when Cole and Perfetti (1980) asked four- to ten-year-olds to monitor texts read aloud for syllable-initial mispronounciations of at least one distinctive feature, even four-year-olds gave evidence of the use of linguistic context in processing. They detected more errors in words predictable from their full left context, in words predictable from the immediately preceding word, and in second syllables of words, than in the matching conditions where contexts did not predict the true form so strongly. Where reaction time data was available, it followed the same pattern as for adult controls: the errors in predictable items were responded to faster than in the unpredictable. But younger children were both worse and slower than older. When we recall that the experimenters did not even find it worthwhile to collect reaction time data from the preschool and kindergarten groups, we see that the similarity of response patterns across age masks a real difference in the ease with which children could produce those responses. Cole and Perfetti try to excuse the incompetence of the youngest children, whose error detection rate was only 38%, by proposing that they might ignore many planted mispronunciations because they thought they were correct pronounciations of unfamiliar lexical items. This explanation bodes ill for ordinary word recognition in young children: if any perceived deviation from canonical word shape encourages a child to suppose that a new word is being said, how will he ever manage to recognize the highly variable tokens of familiar items?

Two experiments by Tyler and Marslen-Wilson also show changes at the lower end of the testable age range, though their discussions stress a uniformity of processing mechanisms in children aged five to eleven. The first (Tyler and Marslen-Wilson, 1978) required pre-screened five-, seven-, and ten-year-olds to repeat verbatim the text just before an interruption to a story or to a syntactically analagous sequence of meaningless strings. In Jarvella's (1971) original experiment along these lines, adults had recalled the words in the clause immediately preceding the interruption markedly better than the clause before that and had shown a scalloped curve, not dissimilar to the serial position effect, for word recall in each clause. Jarvella construed these patterns as indicating that once a clause's boundary is passed, its representation in memory becomes more abstractly semantic so that its original constituent words cannot be recalled. The children in Tyler and Marslen-Wilson's study showed a different pattern of responses. Five-year-olds did not show the double-scallop curve for word position over the two clauses while the older children gave some indication of clause boundaries in this measure. Five- and seven-year-olds did better on the main clause of the sentence and worse on the subordinate, whatever their order. Eleven-year-olds showed a trend in this direction as well. The experimenters stress that there was no age effect in general success rate and that normal prose was always easier to recall than syntactically acceptable meaningless strings so that all children must have been able to process the sentences and profit from semantic information. They do admit that the failure of the five-year-olds to show clause boundaries implies that they may be making an instantaneous translation from surface strings to semantic readings regardless of syntactic clause boundaries and that the bias toward main clause recall also implies a concentration on semantic information not seen in adult results.

The second study (Tyler and Marslen-Wilson, 1981) asked five-, seven-, and ten-year-olds to monitor for particular words or for words belonging to a particular semantic category in normal and syntactic prose (a meaningless but syntactically acceptable version as above) and in random reorderings of the latter. Throughout the tasks, older children responded faster. There were no interactions with age for the reaction time advantage of normal over syntactic over random strings when subjects monitored for a named word, and these prose-type effects increased for targets placed later in the sentences. Thus all the children scored better at word identification when syntactic and semantic information could be recruited to the task and all could use this information cumulatively over a sentence. But in monitoring for a member of a named category, age effects were seen. Some younger children refused the task. The advantage of normal over syntactic prose increased with age, as if older children could make more efficient use of sentence meaning in finding a category member. Younger children took longer to recruit semantic information in any given sentence structure. The experimenters again stress the qualitative similarity of results over the three tested ages but the differences in the category monitoring task imply once more that semantic information applies under a different schedule in younger and older children. Only the latter show the pattern found for adults in the category task (see Marslen-Wilson and Tyler, 1980)

Two further studies will serve to contrast the child's use of syntactic structure as structure and as a clue to meaning. Entwistle and Frasure (1974) found that chuldren's ability to repeat semantically anomalous but syntactically acceptable strings rises with age (6-9), while Barclay and Reid (1974) found that children from five to ten were statistically indistinguishable in their recall of stories containing full and truncated passives. As the correct actors were assigned to actions whenever they were named in the passage, these children were able to use both the word *by* to direct them to the NP and its absence to direct them elsewhere in the text in their search for actors.

In general, then, even four- to ten-year-olds whose productive grasp of language may be difficult to distinguish from adults' are still developing adult-like use of linguistic information in sentence processing. It would be quite surprising if one- to three-year-olds, whose speech is clearly immature, were not even less accomplished at employing higher order linguistic information for perceptual ends. Although evidence for some use of this information is easy to come by, the striking characteristic of earlier processing is the brilliance with which younger children exploit another kind of information: the structure of extra-linguistic context.

III.C. What Help Can Be Found in Extralinguistic Context?

There is a considerable body of work which shows that extra-linguistic context is extremely important to children's apparent word meanings. Indeed it is argued that contexts rather than word meanings are often the basis for children's responses in studies of lexical development. If extra-linguistic contexts control responding in experiments, it is but a small step to the position that they operate whenever we think the linguistic signal is being processed. In this section we will trace this progression of thought and conclude by discussing studies of the interleaving of extra-linguistic and linguistic strategies in sentence interpretation.

III.C.1. The Development of Word Meaning

Observing the findings of Donaldson and Wales (1970) and Donaldson and Balfour (1965) that preschool children sometimes responded to 'less' as if it meant 'more', H. Clark (1970) and E. Clark (1973) originally proposed that children's lexical entries begin as very small sets of semantic features and develop by the subdivision of the extensional universe which additional features imply. Thus 'less' meant 'more' because the former belonged to the lexical field for quantity but lacked a feature for [negative pole]. Soon, however, experimental investigations revealed that the same words appeared to have different lexical entries when the child's knowledge of them was tested in different situations.

For size and for quantifiers, younger children show a bias toward acquiring larger or more things and surrendering smaller or less. Donaldson and

McGarrigle (1974) found that the apparent meaning of 'all' was 'all that there are' for an array of cars on a flat surface but something akin to 'all I could get' when the same array was covered by a garage-like structure with one empty bay. And 'less' was treated as 'more' because three- and four-year-olds preferred pointing to a larger array or adding to a given amount, whatever words the instructions happened to use (Trehub and Abramovitch, 1978; Carey, 1978a). Not dissimilarly, three- to six-year-olds often short-circuited an instruction to choose a rectangle greater in one dimension than in another by consistently choosing the one with the greatest area (Townsend and Erb, 1975). But when children were asked to part with the big/little, long/short, wide/narrow or just one member of a pair, they were more willing to part with the lesser in any dimension and so seemed to have fuller lexical entries for the negative member of a polar opposition than for the positive (Eilers, Oller, and Ellington, 1974).

Locational terms also elicited different responses when tested with different combinations of objects. Movable objects tended to be placed in containers and on surfaces, whichever relationship was asked for (Clark, 1974), and later interpretations were markedly more adult-like for the same instructions with congruent referent objects (*boat under the bridge*) than for incongruent (*road in the truck*) (Wilcox and Palermo, 1975). In fact, two- and three-year-olds showed markedly different 'comprehension' when asked to put one cardboard box in, on, or under another depending on whether the boxes were *called* boxes, chair and table, baby and bath, or cup and table (Grieve, Hoogenraad, and Murray, 1978). And when the prepositions are replaced by other locational terms, responses to 'top', 'bottom', 'front', and 'back' also depend on the object in question: vertical terms are more successfully interpreted on objects with inherent fronts and backs (Clark, 1980).

The studies comparing responses to real and nonsense words (Carey, 1978a, and Wilcox and Palermo, 1982) are perhaps the most crucial here. If children merely change their responses to a word in different extra-linguistic contexts, we might say that they do have a meaning for the word but that its application is contextually dependent. If, however, children treat a doubtful word exactly as they treat a nonsense word for which they can have no lexical entry, we must wonder whether the embattled item has a lexical entry at all or whether contextually determined response biases merely give it the appearance of having one. This is Carey's position, for she finds that responses to 'more', 'less', and 'tiv' significantly fail to show the pattern required by Clark's original hypothesis whereby making a quantity 'more' means adding, 'less' also adding, and 'tiv' not adding. Rather 'tiv' and 'less' elicited adding to roughly equivalent extents (63% and 72% of errors). Struck by the similarity between errors for real and nonsense prepositions and the dissimilarity between errors in congruous and incongruous contexts, Wilcox and Palermo (1982) propose that children first learn to process extra-linguistic contexts and base their responses on them. They see this learning as distinguishing all their older Subjects from the two-year-olds who did equally badly in congruous and incongruous contexts. While the children showed in their behaviour towards sequences of nonsense preposition instructions an awareness that different word shapes might expect different responses, it was only from age three that they appeared to acquire distinct meanings for the real lexical items: in each successive age group more subjects showed a reaction time advantage for real over nonsense words presented in neutral contexts. Thus children may spend some years deceiving adults about their command of lexical items by cleverly attending to the contexts in which they are uttered. (See also Huttenlocher, 1974; Clark, Hutcheson, and van Buren, 1974).

This case can be carried over into the development of a word's phonological entry with reference to another study of Carey's (1978b). Here nursery children were presented with the word *chromium* as a name for the color olive. While the initial presentation contrasted familiar objects newly colored olive with similar ones in red and blue and while the word itself appears to have been repeated under contrastive stress, the outcome was the opening of a very incomplete lexical entry. Some children retained the word's shape without a clear meaning, while others lacked the phonological part of the lexical entry but were aware that the color olive had a name of its own. In either case, the missing information might not be filled in over 18 months of occasional testing. Thus a child could observe a new word's extra-linguistic context and the fact that its acoustic shape was novel but fail to process the shape in any detail.

III.C.2. Sentence Processing

The same dependence on contextual information has been shown to operate in early processing of sentences as well as of words. Clark *et al.* (1974) pointed out that much of what passes for sentence comprehension is probably driven by a grasp of actions appropriate to the extra-linguistic context. In fact it is possible to see results on early sentence processing as depending on three tendencies on the part of the child listener: a propensity to treat adult utterances as directives capable of being complied with, an appreciation of event probability, and a preference for Actor-Action-Object constituent order. Of these only the last is syntactic and then only trivially so.

The first tendency, to treat utterances as directives, is encapsulated by

Shatz (1978a) as 'Mother says; child does,' and is elaborated (Shatz, 1978b) as a propensity to perform possible actions on available objects if the words for either are perceived in the adult's speech. The supporting results come from studies of the responses of one- and two-year-old children to natural and experimentally induced direct and indirect directives. In both studies, the bulk of children's responses which showed any appreciation of the words in the request were actions (>75%). In no case did simple imperatives elicit appreciably more action responses than the various indirect forms, including some which did not mention the appropriate action ('The cup is on the floor', 'Can the circle go in there?' etc.) and one which was anomalous as a directive ('May you...'). Shatz proposes her simple explanation for these results because the standard account of adults' processing of indirect requests (Clark and Lucy, 1975) involves complex and cyclical processing which it would be absurd to attribute to a child with the m.l.u. of one or two. Instead the child may go straight to the content words he recognizes whatever their linguistic surroundings and use them to guide his actions. Ultimately, however, the child becomes increasingly able to take indirect requests as demanding information rather than action. Shatz (1978b) found that the older children were more readily biassed towards informing responses when an indirect request was preceded by statements though they still produced action responses for virtually all those preceded by direct requests.

Shatz' proposals may help to explain other results in early processing. The subjects in Shipley, Smith, and Gleitman (1969) who at the one-word stage, responded to telegraphic commands could simply have ignored the nontelegraphic words. Those in Petretic and Tweney (1977) who obeyed multi-word imperatives need only have recognized a single word. Those in Wetstone and Friedlander (1973) who ignored some aspects of word order were only behaving according to Shatz' plan. Those in Sachs and Truswell (1978) who obeyed two word commands (V+N) could apply the action strategy without interference from additional words. Though the directives in this study were lexically contrastive ('tickle teddy' vs 'tickle dolly' vs 'kiss teddy') and occasionally bizarre ('tickle truck'), Sachs and Truswell are at pains to point out that they require no real syntactic processing. The relationship action-object can be effectively assigned by a response bias rather than via an appreciation of constituent order. It is worth noting that none of the requests in any of these studies was without contextual support. Mothers and experimenters both asked these young children to act on objects which were present at the time and already u'stood by the child for the same obvious reason: without extra-linguistic support, the child is not expected to respond at all.

The second tendency is nothing more than the appreciation of the likelihood of events which we saw earlier in children's processing of locational terms. Now, however, it is reembodied in the notion of reversibility of the Agent-Object relation, for the only way to create a non-reversible sentence with a sytactically permissible passive is to use nouns with markedly different probabilities of performing the action on each other (eg. mosquito + bite + boy, cat + chase + dog). Since only psycholinguists and story tellers produce sentences in which the unlikely relationship is intended, children can go a long way towards understanding sentences if they map them onto the real world and ignore their syntax. It is in just this connection that the notion of the reversible sentence entered the literature. Slobin (1966) showed that for children aged six to twelve, passive sentences were no harder than actives so long as the lexis made it plain who did what to whom. Once there was any doubt which only an appreciation of syntax could resolve, passives began to elicit errors. The syntax of passive sentences was unavailable to children who often processed them correctly.

The children's bias toward taking reversible passives as actives is the substance of the third and only really syntactic strategy in early processing. It was Bever (1970) who first reported that children of two to four tend to impose an Actor-Action-Object strategy where morphological details should block it. But the development of this propensity and its interaction with the probable event strategy are explored more fully in Strohner and Nelson (1974). Acting out transitive sentences, two-year-olds scored over 50% on reversible actives, where the Agent-Action-Object strategy gives the right reading, and under 50% on reversible passives where it does not. They were always correct on probable actives where both strategies provide the correct response and usually wrong on improbable actives. As the Actor-Action-Object strategy would work here, the low scores indicate that the probable event strategy takes precedence in young children. For three-year-olds, both event probability and the Actor-Action-Object strategy have gained strength, as nearly all probables are correct and all improbables wrong, and as the reversible actives are much more likely to be correct than the reversible passives. At age four both effects are less marked and by age five they retain their hold only for the difficult improbable passives, where both strategies yield the wrong interpretation. As reversible actives and passives and probable and improbable actives show no biases, the five-year-olds must be developing a real appreciation of the syntax of passives. But this development, which coincides with the starting point of the studies on adult--like processing (Section III.B), follows three years in which a knowledge of the way the world works and a simplistic notion of the English word-order constraints seem to dominate sentence interpretation.

The important point here is that at the start of this process, children appear to be letting their understanding of events substitute for an examination of sentence structure. When they command little of the language's syntax, the younger children still have something besides acoustic information to depend on in their attempts to identify words and meaning in speech. The work of Shatz and of Strohner and Nelson suggests that given a grasp of the way things happen in the real world, children will need only the lexis for common events and objects to respond to the sorts of things which are often said to them. Yet Carey's and Wilcox and Palermo's conclusions might make us cautious in assuming lexical knowledge. If many children of three and four have neither phonological nor semantic lexical entries for common prepositions and adjectives, then children of one or two may have similarly ghostly representations for some nouns and verbs. Certainly we know that their phonetic and semantic interpretation of nouns and verbs can be every bit as eccentric as their later renditions of relational terms. One might almost be tempted to follow this line to the extreme conclusion that young children see *through* adult speech to the world around them, only occasionally and partially sampling the signal itself. While they may thus simulate speech processing to a degree which will convince adults, -- who will always give children the benefit of the doubt -- , this supra-processing strategy would only work in the short term. The course of first language acquisition must be marked by increasing ability to attend to and learn from the linguistic signal itself.

Of course, the use of extra-linguistic context could aid speech perception at each stage by narrowing the possible word identities for stretches of the acoustic signal, just as the announcement of a category name or word associate did for adults in intelligibility experiments. But these contexts only predict which members of already familiar sets of words are likely to be present. They tell us nothing about how new members are added to the sets.

Since children are estimated to learn 14,000 words (not to mention bound morphs) between the ages of eighteen months and six years they must be adding to the set at the average rate of nine new members a day (Carey, 1978b). Since few words are likely to be introduced deliberately in citation form, the child must almost constantly be acquiring new words by picking them out of the speech stream. While the extra-linguistic context might provide salient referents for new words, it is difficult to see how it could overcome any articulatory inadequacies in them. As context will not account fully for speech perception in language acquisition, we must hope that some solution lurks in the quality of the linguistic input itself.

IV. Parental Speech as an Aid to Language Acquisition

As the literature reviewed thus far offers only modest hope that young children can recruit sufficient higher order information to overcome the acoustic inadequacy of ordinary speech, we will now ask whether children's linguistic input might differ from that speech in some helpful way. Within the literature on 'motherese' as this speech is (rather inaccurately) called, there are findings pertinent to this issue, but they can be evaluated only in the light of the answers to a more general question: Does the nature of speech to young children ease the burden of language acquisition?

To see how the findings in this field tend to reply, we should understand why they were generated. Although some notes on adult speech to children antedate the controversy (Chamberlain, 1890, 1893; Casagrande, 1948; Austerlitz, 1956; Vogelin and Robinett, 1954; Cassar-Pullicino, 1957), most work in this field is intended to refute Chomsky's insistent claim (1965, 1975, etc.) that language is innate. Because children acquire first and second languages without obvious instruction and in the face of the fact that:

'much of the actual speech observed consists of fragments

> and deviant expressions' (Chomsky, 1965, pp200-201)

and is of

> 'degenerate quality and narrowly limited extent..., the striking uniformity of the resulting grammars... leave[s] little hope that much of the structure of language can be learned by an organism initially uninformed as to its general character.' (*op. cit.*, p.58).

Whether children actually do acquire grammars of any uniformity (see Schaerlackens, 1973), or whether they should be said to acquire grammars at all (Bever, 1970) are separate issues. The researchers whose work we will now review realized that there was no *a priori* reason to consider the speech addressed to children to be degenerate in any relevant sense. As of the 1960's, information as to its character was almost totally lacking.

The studies which resulted can be grouped under three major premises. Each of these furthers the argument that a particular sort of linguistic input is a sufficient or even a necessary condition for linguistic development.

First, to be a plausible environmental aid to first language acquisition, speech to children must be identifiably and consistently different from the impenetrably deviant speech which Chomsky describes[2]. Adult-child speech[3] should not only be different from adult-adult speech in potentially helpful ways, but it should show two further characteristics. Its values for the measured parameters should lie within a reasonably small range so that one might suppose that they are entrained by the needs of the young recipient. Also, this identifiable register must be available to all first language acquirers regardless of the language spoken, the social milieu or culture, or the age or sex of the caretakers. If the register is lacking where children quite happily learn to speak, its utility is very much in doubt.

Next, adult-child speech should revert to adult-adult speech in tandem with the development of child language into its adult goal. If the speech register fails to change at all over the course of language acquisition or is more closely linked to behaviors which do not map uniformly onto the growth of language, it might fail to supply particular input features when they are needed.

Thus far the evidence for the role of adult-child speech is only circumstantial. The third requirement on this register, therefore, is that it should show clearer signs of being causally related to first language development. Of the three sorts of studies which one might use here, deprivation experiments, in which children are raised without having any special adult-child speech, occur very rarely in the natural course of events and are unethical to arrange[4]. Intervention studies increase the frequency of certain types of utterance in some children's input and compare this group's progress against the gains made by controls. Somewhat less time--consuming are observational studies which attempt to find significant correlations between the natural rates at which different individuals produce sundry parentese features and the rates at which their children's language subsequently develops.

In summary then, a convincing reply to innatist arguments demands evidence that adult-child speech differs from adult-adult speech in orderly and-potentially helpful ways which are, to all intents and purposes, universal, that it varies with the linguistic development of the child addressed and that it furthers that development. Sections IV.A-C will review the available evidence in these areas and Section IV.D will reassess the resources of the young language learner in the light of these findings.

IV.A. Speech to Children vs. Speech to Adults

IV.A.1. Addressee Differences in Mothers' Speech

As most of the data on adult-child speech is based on recordings of mothers speaking to their own children, all speech to children is often called maternal speech (abbreviated 'MS') or motherese. Though it is an empirical issue whether others talk to children as mothers do, we can begin our examination of the data by looking at motherese proper.

The simplest form of research on maternal speech involves either counting the instances of particular formal and functional characteristics in short, transcribed recordings of mothers' speech to their children or making and averaging instrumental measurements of acoustic characteristics. In order to establish that maternal speech differs from speech among adults, it is, of course, necessary to compare the mother's speech to her child with a control sample of the same mother's speech to an adult. Comparisons yielding significant differences will be discussed here. Those studies which include no control will be used only to provide extra data points in comparisons established elsewhere as significant.

The usefulness of the control depends on its nature. In free conversation, the things a woman discusses with her small child are almost bound to differ from the topics she covers with an adult researcher. In some studies, the functional and structural nature of the conversation are objects of the researcher's attention, and legitimately so. But it is often useful in a preliminary study to fix the topic of the conversation before seeing how the addressee variable affects functional, structural, and formal characteristics of the mothers speech. Studies which do this (Garnica, 1974, 1977; Snow, 1972) provide the stricter formal comparisons. Studies which do not will nonetheless give us some notion of what happens in the real world when all things are not equal.

IV.A.1.a. Physical and Acoustic Variables

Pitch. Two studies report that the fundamental frequency (F_0) of mothers' speech to their small children is significantly higher than the fundamental frequency of their speech to adults. Remick (1971, 1976) recorded conversations between herself and eight mothers of children aged 16 to 29 months in the laboratory and allowed each mother to record a conversation with her child at home. Passages selected for pitch-meter analysis in each sample were the fourteen sentences with the best signal-to-noise ratio. These produced median F_0 values which yield average F_0s of 230.56 Hz to the child and 197.0 Hz to the adult[5]. A Wilcoxon test on the medians shows the difference to be significant at the .01 level, two-tailed. Garnica (1977) notes that Remick's data selection is potentially haphazard and finds her account of her acoustical analysis insufficiently detailed to permit replication. In Garnica's own study (Garnica, 1974), twelve mothers of two-year-olds and twelve of five-year-olds were set at the same three verbal tasks (telling a story about a picture, reading a short descriptive passage and giving instructions for solving a puzzle). Each task was rehearsed with the Experimenter standing in for the child and then performed for the child in the same laboratory environment. Garnica then produced Pitch Extractor readings for the F_0 of the beginning, middle and end of each syllable nucleus of the same fourteen sentences for all *S*s in both conditions. She found no significant difference between the mean F_0 of speech to adults and to five-year-olds (202.8 Hz and 206.4 Hz respectively) but a significant difference between speech to adults and two-year-olds (197.6 Hz and 267.3 Hz).

These findings are somewhat perplexing. While Sachs (1977) argues that infants are particularly sensitive to high frequency speech, she cites evidence which demonstrates only their ability to discriminate pure tones of

250, 500, 1000 and 2000 Hz (Stratton and Connolly, 1973; Kearsley, 1973). Salus and Salus (1974) argue, on the other hand that young toddlers may be unable to hear high frequency speech sounds properly because those auditory fibres which respond to the relevant frequencies are the last to be myelinized. In general, in fact, a high F_0 ought to decrease intelligibility, because the higher the F_0, the more widely spaced the harmonics, which are multiples of it, will be, and the less information the whole set of harmonics will provide about the formants of speech sounds[6].

Pitch Range is greater for speech to children than for speech to adults. Using the data described above, Garnica picked the highest and lowest F_0 reading for each *S* in each condition. The ranges for both two--year-olds and five-year-olds (19.2 semitones and 12.6 semitones) were significantly greater than the range in speech for adults (10.5 and 10.9 semitones). This finding actually does suggest an increased intelligibility for maternal speech. As F_0 rises and falls, it and its harmonics will cross and recross speech sound formants, providing each time more information about the whereabouts of those formants. It may be that only by frequent changes of pitch can the mother compensate for such 'damage' as may be done by a high F_0 in the first place.

Intonation Contour. Though several writers comment on a particular *Ammenton* (Kelkar, 1964; Ferguson, 1977), a sing-song exaggerated intonation contour in speech to children, the only relevant quantitative observations are Garnica's on pitch range (see above) and her examination of final pitch terminals and numbers of primary stresses. In tasks where all sentences were declaratives or imperatives, Garnica found that rising pitch terminals were used 25% of the time to two-year-olds, 9% of the time to fives, and never to adults. Both adult-child differences are significant. In the puzzle instructions, Garnica found, by ear, that significantly more informants used two primary stresses in at least one sentence to a two-year-old than they did to an adult (10 vs 3) but that the effect was not significant for the mothers of five-year-olds (1 vs 2). The single stressed word was always the colour adjective referring to the puzzle part which was to be manipulated. Where a second primary stress occurred, it fell on the sentence's verb, 'push' or 'pull'.

Rate of Speech. As speech rate is a determiner of word intelligibility for adult listeners, it is unfortunate that rate measurements are often confused with amount of speech and may be biassed by the nature of concurrent non-linguistic activities.

The most frequently used measure is words per minute and the general finding that fewer are produced to children than adults. Given the difficulty of removing silent periods from the measured time, words per minute may reflect amount said at least as well as speed of delivery. Since virtually none of the words randomly sampled from similar speech in the present research had durations of over one second (z=4.707, p<.00001), measures converting to much greater durations must be suspect.

Remick's (1971) figures yield a mean of 45.0 words per minute to the children and 115.7 to the Experimenters (p<.001, two-tailed), and these imply an average word duration of 1.333 seconds to children and 0.519 seconds to adults. As only the conversations with children were interspersed with household activities we are surely seeing some effects of unedited pauses here.

Ringler (1973) taped speech addressed by ten Black American mothers to their children at 12 and 24 months while each mother was left alone with her child during a break in a routine hospital examination, and compared this sample with speech produced by the mother while she was being interviewed on topics related to child-rearing. At both the 12-month and the 24-month visits the children heard fewer words per minute (14.2, 50.0, implying durations of 4.225 and 1.200 seconds respectively) than adults did (53.6, 72.9, implying 1.119 and .823 seconds). The very high duration figure for younger children must include the pauses in a situation where the mother felt no compulsion to speak.

Broen (1972) recorded the speech of ten mothers to each of their two children (one aged between 18 and 26 months, the other over 45 months) and to the Experimenters. Speech to the children was collected under two conditions which produced different results. When playing freely with their children, the mothers produced an average of 69.2 words per minute (.867 sec/word) for the younger and 86.2 words per minute (.696 sec/word) for the older. When telling a story based on a group of pictures, mothers increased their speech rates significantly to 115.1 (.521 sec/word) and 127.5 words per minute (.471 sec/word). For both tasks rates of speech to children were significantly lower than for conversational speech to an adult (132.4 words per minute or .453 sec/word). While the implied average durations are more plausible here, we can still not be sure that the effect of addressee on rate has nothing to do with the ongoing task: mothers presumably had to help their children manipulate toys or turn pages but were allowed simply to chat with the Experimenter. An additional speech rate for children was contributed by Cross' (1977) study of the speech of sixteen Australian mothers to their children aged 19-32 months. With no adult-adult control, Cross' adult-child observations yielded a mean of 74.9 words per minute (.801 sec/word) in free conversation, a rate roughly similar to that found in Broen's study.

The picture is not made clearer by the use of two further measures.

Remick's count of syllables per second yielded a mean of 5.17 to children and 5.37 to adults ($p<.05$, one-tailed). Ringler counted the numbers of utterances per minute for her speakers and found them equivalent for adult and child addressees at both interviews, though there was an increase in rate for both between interviews.

A summary of the words per minute studies may be revealing here. Speech to one-, two- and three-year-olds in the work of Remick, Ringler, Cross, and Broen yields a mean of 61.4 words per minute but varies widely: the standard deviation is 30.9, one half of the mean. Speech to adults averages 93.6 words per minute with a relatively smaller standard deviation: 31.7. The difference between these grand means is *not* significant at the .05 level, one-tailed ($t=1.43$, $df=8$). Even omitting Ringler's suspect data, speech to adults ($\bar{x}=124.05$ words per minute, s.d.=11.81) is not sufficiently faster than speech to children ($\bar{x}=76.05$, s.d.=29.08) to overcome the variance among studies ($t=1.83$, $df=6$, $p>.05$). If these measures were true rate indices and if mothers aimed their speech rates at a 'window' of child perceptual ability, one might expect little variability in motherese rate and a sizable contrast with the rate of conversational 'adultese'. Instead the apparent maternal speech rate varies with the ongoing task and/or measurement error much more than the apparent adult-adult conversational rate. Given these results, it is very difficult to argue that a mother's slower speech has more to do with the child's perceptual capacity than with the mother's vague notions about it. Nor is it possible to predict that maternal speech is intelligible because it is slow. Controlling for task and lexical items, Garnica (1977) compared the average time mothers took to pronounce all tokens of colour terms and of the verbs 'push in' and 'take out' in her puzzle instructions. Both sets of words were pronounced more slowly for two-year-olds than for adults. Only colour words showed that difference for five-year-olds. Taken together with Garnica's findings on primary stress, this suggests that mothers may change the speed and pitch characteristics of their speech by using more primary stresses per utterance when speaking to children. Syllables with primary stress are supposed to be articulated more slowly, to be louder, and to show more pitch change than other syllables. Merely by increasing the ratio of primary stresses to sentences, then, mothers might change the rate and intonational character of their speech. What such changes have to do with the nature of the child is not clear. On the other hand, they are what is to be expected from an adult who is taking care to speak emphatically.

Word Boundary Phonology. Shockey and Bond (1980) sampled the speech of eight British mothers to their children, aged two to four, and to an investigator who spoke in the local accent. Within these, they found a significantly higher rate of application of three phonological word boundary rules ([t] -> [ʔ]/--#; ð -> ∅/ $[{}^{+cont}_{+cor}]$#--; [ts] -> s/--#) in speech to the children. Far from being more decipherable without higher order information, speech to language—learning children is more likely to present non-canonical word forms.

Pauses are distributed differently in adult-adult and adult-child speech.

Broen (1972) examined one minute of four mothers' speech to their younger ($\bar{x}$=21 months) and older ($\bar{x}$=60 months) children and to her. Of pauses at least 260 msec long, the following percentages fell after multi-word sentences, after one-word utterances and within sentences: 75.4, 23.2 and 1.4% respectively for the younger children; 82.9, 6.5 and 10.6% for the older; and 51.2, 2.6 and 46.2% for the adult. Both adult/child comparisons are significant (χ^2 (older/adult)=31.48, p<.001) and the main difference seems to be the greater number of within-sentence pauses in speech to the adult. Dale (1974) also found a high proportion of pauses between sentence in ten mothers' speech to their two or three-year-old children: 94%.

It would seem that mothers do not hesitate within sentences when speaking to their young children. In fact, they mark nearly every (independently determinable) sentence boundary by a pause: Broen found 92.9% so marked for younger children, 76.5% for older ones, but only 29.4% for an adult. Again the adult/child differences are highly significant (χ^2 (younger/adult)=82.21, df=1, p<.001; χ^2 (older/adult)=42.65, df=1, p<.001)[7]. Another comment on pauses comes from Messer (1980). By video recording 42 mothers with their eleven-, fourteen-, or twenty-four-month-old children, he was able to show that there were longer pauses between successive utterances referring to two different toys than to the same toy. Particularly for the younger children, the long pause was devoted to leaving one toy and picking up another. So some pauses mark a change in objects to be attended to.

Amplitude. One study indicates that amplitude in maternal speech is used to special effect. Working from recordings of 15 mothers speaking to their 14-month-old children during short play sessions, Messer (1981) found a greater than chance tendency for toy names to be the loudest and the last word of an utterance. Because last words were not necessarily loudest, we can see Messer's results as expanding on Garnica's. Whereas she found major stress on crucial descriptors and actions, his later study shows one concominant of tonic stress attached to names of objects in current use. Since no adultese is examined here, however, we cannot tell whether this attachment is peculiar to maternal speech. Still the implication that toy names receive tonic stress suggests that they should be more intelligible than other words.

IV.A.1.b. Amount of Speech

Though Remick counted significantly fewer words addressed to children than to adults, the comparison is made meaningless by the fact that mother-child recordings were shorter than mother-Experimenter recordings. Better figures come from a study by Snow (1972) who compared the speech of mothers of ten-year-olds with that of mothers of two-year-olds. In each case the speaker gave a set of instructions to her own child and on a separate occasion recorded the same instructions as if she were speaking to her child. On neither occasion was the Experimenter present and both recordings were made in the laboratory. Although no comparison with speech to adults is available for this task, speech to the ten-year-olds was so often like speech to adults in other studies, that the older children may be treated as adults for the purposes of the present discussion. Mothers of two-year-olds used on average significantly more words instructing their children in a set task than did mothers of ten-year-olds (1448.2 vs 861.2)

When their children were present, both groups of mothers in Snow's study produced more words per task than they did in dry runs, but the effect was far larger for two-year-olds' mothers and the interaction was significant. The importance of the child's presence is clear, but what is not so clear is what sort of feedback he provides or what controls the feedback. We will revisit this issue in Section IV.B.

IV.A.1.c Measures of Syntactic Complexity

If MS is to be a useful exemplar for the induction of linguistic rules or if its structure is to be within reach of the child's rudimentary syntax in processing, the register should display simple and orderly syntax. Although simple is not a well-defined term in this context, most researchers in this field seem to think that simplicity and complexity have to do with the amount of branching in a sentence's Chomskyan deep structural tree. Accordingly, they have measured the mean length of utterances, the number of deep structure sentences in each, and the proportion of nouns and verbs which have modifiers. Each of these measures is sensitive in some way to the number of branches beyond those in the simplest imaginable Noun Phrase + Verb Phrase tree.

M.1.u. As Brown (1973) computes it, m.l.u. or mean length of utterances in morphemes, will reflect both the number of words used and the number of inflections in them. When applied to the speech of mothers, m.l.u. has been measured in words or in morphemes. While each individual m.l.u. count shows that utterances to children are shorter than utterances to adults, the variability among studies again seems to prevent summary figures from showing a significant difference. In the study described above, Ringler's (1973) Analysis of Variance revealed a significant difference between her informants' m.l.u. (calculated in words) in speech to their children (2.61 at 12 months, 3.48 at 24) and to the Experimenter during the same hospital visits (7.05 and 8.51). Phillips (1973) also collected speech from mothers directed towards herself during one part of a session and speech directed toward the child during a play session at which she herself was not present. For 10 mothers of 8-month-old boys, 10 of 18-month-olds and 10 of twenty-eight-month-olds, m.l.u. (in words) of speech to the child (3.56, 3.47, 4.01) was lower than that of speech to the Experimenter (8.46, 8.37, 8.47). Phillips reports a replication of this finding on 28 mothers of girls.

Newport, Gleitman, and Gleitman (1977) (reported also in Newport, 1976, and Newport, Gleitman, and Gleitman, 1975) recorded two hours of free conversation, with mother, child and Experimenter present, for five mothers of girls aged 12-15 months, aged 18-21 months and aged 24-27 months. In a sample of 100 utterances to the child and 50 to the Experimenter in each interview, the m.l.u. (in words) to the child (4.94) was significantly lower than that to the adult (11.9).

Further free-play studies provide additional data points. Cross (1975, 1977) reports that mean maternal m.l.u. to sixteen linguistically advanced children aged 19 to 32 months was 4.8. Longhurst and Stepanich (1975) found the following m.l.u.'s (in words) : 3.69 to one-year-olds, 3.85 to two-year–olds and 4.70 to three-year-olds. Each mean is based on the speech of twelve mothers. Furrow, Nelson, and Benedict (1979) report word m.l.u. of 4.03 and 3.94 for the same seven mothers to their children at 18 and 27 months.

The sole example of an m.l.u. difference in a set task comes from Snow's between-groups study. The m.l.u. (in words) for the speech of the mothers of two-year-olds (9.84 when the child was absent, 6.60 when he was present) was significantly lower than that for the mothers of ten-year-olds (11.25 when absent, 9.63 when present).

It is interesting to note that while the m.l.u. values cited in the other studies for children aged two or just under range from 3.47 to 4.94, Snow's figure, 6.60, is considerably higher. Whether this discrepancy displays a characteristic difference between instructions and conversation or whether it is merely an example of the considerable sample to sample variation (compare Ringler's and Phillip's figures, for instance) remains to be seen. At any rate, when all word-based m.l.u.'s to one and two-year-olds (as cited above from the comparative studies of Newport *et al.*, Longhurst and Stepanich, Phillips, Snow and Ringler) are examined, m.l.u. to children is 5.08 (s.d.=1.29) while m.l.u. to adults is 9.38 (s.d.=1.36). The difference is not significant (t=1.37, df=14, p>.05. one-tailed). But if Snow's data are eliminated, the difference (3.96 s.d.=.43 to children, 9.32 s.d.=1.51 to adults) is significant (t=6.46, df=8, p<.005, one-tailed). Thus although mothers do not always maintain a limited and distinct range of utterance lengths for toddlers, they can do so within a particular situation[8].

Sentences of more than one Sentoid. In general, the sentences addressed to young children will have fewer S-nodes or sentoids in their standard Chomskyan deep structure trees than sentences addressed to adults. Evidence for this statement comes from a number of measures.

The ratio of compound and complex to simple sentences is lower in mother--child than in mother-adult speech. Ringler (1973) found more simple sentences in mothers' speech to their children (78% to 12-month-olds, 79% to 24-month-olds) than to adults (46%, 41%). Remick's (1971) figures yield an average of 24.9% of clauses in speech to children marked as compound or subordinate, while 69.1% of clauses directed to adults are so marked (t=16.63, p<.001, two-tailed). Phillips (1973) counted verbs per utterance, as each verb represents a clause or sentoid. For speech to children the ratio was significantly lower, in fact less than 1.0. Curiously enough, Cross (1975) who investigated speech produced by mothers of linguistically normal or linguistically advanced children (N=8 in each group) aged from 19 to 33 months, found that both heard utterances of about one sentoid ('proposition') in length. No values for speech to adults were taken. Still if Cross' results are equivalent to Phillip's, mothers may, on average, produce single sentoid sentences -- with or without a verb.

Other measures show specifically that there are fewer subordinate clauses (or embedded sentoids) in mothers' speech to their children than in speech to older listeners. Ringler (1973) found a significantly higher ratio of main clauses to all clauses in speech to one- and two-year-olds. Remick (1971) counted fewer clauses (12.1%) marked as complex in speech to children than in speech to adults (37.6%, $p<.001$, two-tailed). Snow (1972) calculated the ratio of compound verbs (that is, verbs taking verb phrases as complements) plus subordinate clauses to the total number of utterances for each speaker, i.e. roughly the number of embedded sentoids per utterance. This was significantly lower for mothers of two-year-olds than for mothers of ten-year-olds. The age difference was only significant when the children were present and the presence/absence effect was significant only for the younger children. Thus, there is something in the presence of a two-year-old in need of instruction which is associated with her mothers production of one sentoid sentences.

Modifiers. One study (Phillips, 1973) shows a lower incidence of modifiers (adjectives, adverbs, relative clauses) in speech to young than to older listeners, while another study (Snow, 1972) finds no significant difference in the number of sentence subject modifiers. Snow's measure did significantly decrease when the two-year-old was present. Again the presence of a young child is associated with a reduction of constituent length, and one assumes, complexity, in the mothers speech.

IV.A.1.d. Other possible Sources of Psycholinguistic Complexity

Insofar as it means anything beyond sy^n^tactic complexity, the notion of psycholinguistic complexity in adult-child speech is a much less transparent one than any we have dealt with hitherto. It presupposes both a strong suspicion about what constitutes psycholinguistic complexity for the adult listener, and a strong hypothesis that the child at these very early stages is perceptually similar to the adult. It is apparent both from the counts experimenters make and from their overt declarations (see especially Newport *et al.*, 1977, pp.126-129) that they have views on the psycholinguistic nature of the adult which they generalize to the child.

Those who study maternal speech take for granted the common assumption that transformed the psychology of language into psycholinguistics: that human language behaviour, like virtually every modern linguistic theory, is sentence-based. While we do have evidence that some forms of processing are cavalier about sentence boundaries (Bransford and Franks, 1972; Marslen-Wilson and Tyler, 1980), the study of sytactic development has been preoccupied with the Chomskyan notion that human beings produce and comprehend language in units equivalent to regularized or grammatical sentences, or at least to complete propositions. Thus, 'the cat sat on the mat' is assumed, paradoxically, to be a simpler stimulus than 'on the mat'.

Furthermore most of these studies presuppose left-to-right single pass processing, the importance of sentoid units within sentences and the Actor-Action-Object strategy (Fodor, Bever, and Garrett, 1974). As we have seen in Section III, there may be a case only for the last of these in children as young as two. Nonetheless these are the views which led researchers to expect that 'helpful' maternal speech should contain sentences with few sentoids and a high incidence of 'canonical order' (S-V-O), and that it should be much less degenerate syntactically than adultese. We have already seen that the first prediction is true. The second is not, and the third is debatable.

Fragmentary Utterances. Though there are significantly more verbless utterances addressed to small children than to adults, other areas of failure to create grammatical sentences show no significant difference for addressee. The expected difference, however, is shown by counts of disfluencies and complete failure to construct a recognizable utterance.

As was mentioned above, Phillips (1973) found a lower ratio of verbs to utterances in speech to small boys (.82, .84, and .92) than to the experimenters. Snow (1972) found that the speech of mothers to their two-year-olds contained significantly more verbless utterances than did the speech of mothers to their ten-year-old children. When two-year-olds were present, 16% of maternal utterances lacked verbs and if we suppose that all of Phillips' utterances with verbs had only one verb, Snow's figures agree very well with Phillips'. The finding by Newport *et al.* that 'Do you' is deleted in 6% of its expected locations when mothers speak to their children, but not at all in their speech to adults, suggests at least one of the ways in which some verbs may be 'lost'. This sort of informal speech ('Want to drink your juice') seems plausible enough in speaking to children, but note that it violates the prediction of sentential completeness.

The prediction receives no further support from several other measures. Ringler's (1973) averages of percentage of incomplete clauses and sentence fragments, the estimate in Newport *et al.* of the percentage of phrase (as opposed to sentence) utterances and Remick's values for percent of words contained in well-formed clauses all show no significant difference with addressee.

The hypothesis that perfect sentences are 'good' stimuli and should, therefore, be frequent in speech to children receives its only support from the fact that major faults in sentence production are more often found in speech to adults than in that intended for children. Newport *et al.* (1977) found significantly more disfluencies (false starts, hesitations, revisions, word repetitions, or long pauses) in speech to adults (5%) than in speech to children (1%) and similar differences are reported by Broen (1972). Newport *et al.* also found a comparable difference in the proportion of utterances which were so unintelligible or so incomplete (it is often impossible to say which) that the transcribers were unable to give any account of them (9% and 4%). Thus, while there is about an equal chance of a mother's producing a syntactic flaw speaking to a child and to an adult, there is a greater chance that she will lose her way in a sentence directed towards a mature listener. It is tempting to suggest that the more complex sentence structure she produces for adults will lead her into syntactic and mnemonic blind alleys, whereas the one sentence-one sentoid issue for children gives her fewer chances to get lost.

Word Order. Unfortunately for any child developing an Actor-Action-Object strategy, in most studies fewer Subject-Verb-Object sentences are addressed to children than to adults.

Ringler (1973) found significantly fewer declarative sentences (21 and 13%) addressed to children than to adults (96 and 95%) and Newport *et al.* (1977) cite figures of 30% to children and 87% to adults. It is interesting that Remick's data, though showing a significant difference in the same direction as the others, yield a much higher mean percent of declarative sentences (61%) directed at children. In fact χ^2 tests on the proportions of declaratives and non-declaratives addressed to children show that Remick's figures differ significantly both from Ringler's (χ^2=47.4, p<.001, df=1) and from Newport's (χ^2=18.1, p<.001, df=1). Since Remick's samples were potentially the most naturalistic, -- they were taped at home by the mothers themselves -- , we may suspect a certain exaggeration in other data.

Unsurprisingly, more imperatives are directed at children than at adults (Newport *et al.*, Ringler), but, of course, imperatives are subject-less sentences and contribute moderately (18% of all sentences in Newport *et al*) or heavily (58 or 59% in Ringler) to the percent of sentences which are non-canonical.

Similarly, questions of all forms, yes-no, and wh-questions have been found by at least one study (Newport *et al.*) to be more frequently addressed to children than to adults. Ringler, however, found no significant addressee effect in her question count, although she did find a difference in the same direction as Newport *et al.*

Two further comparisons lend support to the view that the distribution of sentences types is determined by the structure of the conversation rather than some form of perverse syntactic selectivity. Ringler, if not other researchers, reports a significantly larger percent of negative sentences in speech by her ten mothers to their children than to her. Negatives, of course, do not re-order subject, verb and object, but they do change the nature of a conversation. Since more than half of the sentences these mothers addressed to their children while waiting for the second part of the interview to begin were imperatives, a sizable proportion of the negative sentences (themselves over 90% of the total) must have been prohibitions. It is easy to see the utility of prohibitions as well as of negative statements in keeping a restless child under control in an unfamiliar place. It is just as easy to imagine the usefulness of the many questions asked by Newport *et al*'s mothers, who were, after all, under the impression that the investigation was interested in the child's speech. It happens in English that non-S-V-O sentences are used to control the listener's behaviour and mothers seem far more likely to feel some responsibility for controlling their children's behaviour than for directing the activities of an interviewer[9]. A second point is worth noting in this connection. When Newport *et al.* counted other deformations of S-V-O order (optional movement transformations etc.), they discovered that more of these sentences were addressed to adults (45%) by all the mothers than to children (28%). Thus, the mothers in this study were avoiding S-V-O sentences only in the sense that they were choosing those sentence structures which English uses for affecting the listener's overt behaviour.

IV.A.1.e Use of Form Classes

Brown and his colleagues noticed early in their longitudinal study of language acquisition (Brown and Fraser, 1963; Brown and Bellugi, 1964) that children's first multiword utterances were much more often composed of members of some adult-language form-classes than of others. They described the morphemes children use as referential rather than non-referential terms. That is, children use the morphemes we call nouns, pronouns, adjectives, verbs and adverbs rather than conjunctions, prepositions or inflections. Brown wondered whether this distribution had anything to do with the frequency of the relevant form classes in the speech his subjects heard from their parents. When he later asked a similar sort of question about the acquisition order of certain types of interrogative sentences (Brown and Hanlon, 1970), he found a significant positive correlation between the frequency of particular sorts of question in mothers' speech and the order in which the questions came to be produced correctly in their children's speech. Controversies about the data notwithstanding (Moerk, 1980; Pinker, 1981), there is considerable interest in the distribution and usage of form classes in maternal speech. Yet few of the predictions we might make about motherese as the model language seem to be fulfilled.

Functors and Contentives. Fewer functors (grammatical words) and more contentives (lexical words) appear in mothers' speech to children than in their speech to adults. While this is the sort of finding one would expect to underlie the preponderance of contentives in children's own early utterances, the two relevant studies differ in the percentages they report.

Ringler (1973) and Phillips (1973) both found significantly greater numbers of contentives in mothers' speech to children. Ringler's informants, who were speakers of Black American English, produced 55% contentives for their 12-month-old children and 61% for the same children a year later. Phillips' informants were wives of house staff at John Hopkins Hospital and were, one assumes, largely speakers of Standard American English. Their proportion of content words was 35% for 8-month-olds, 37% for 18-month-olds and 36% for 28-month-olds. A χ^2 on functor/contentive ratios for Ringler's data and for Phillip's two older groups misses significance at the .05 level. The difference could be due to different functor usage in Black and Standard American English or to differences in interview structure. The fact that Ringler's *S*s directed more content words toward her (44%, 49%) than Phillips' toward her (31, 32, 33%) supports this view. Again the difference just fails to be significant (χ^2=3.82, df=1, p=.05). One surely has cause to wonder whether contentive/functor ratio might be another area in which mothers make some adjustment without some special window to aim for.

NPs. There are significant differences between adult-directed and child-directed speech in the choice and use of nouns, in the frequency of certain kinds of deixis, and in the use and relative frequency of pronouns.

Phillips (1973) found that the average concreteness rating (Paivio, Yuille and Madigan, 1968) of nouns produced by mothers for their 28-month-old sons was significantly higher than that of nouns addressed to the adult.

Ringler's study suggests an interaction between noun use and the preference for concrete nouns in speech to children: in such speech, nouns were more often used as actor and place and less often as object and time than they were in speech to her. While actors and places must be concrete, objects may not be ('stop that *noise*') and time never is. If the preference for concrete nouns is very strong, we would expect a virtual absence of uses requiring abstracts and a low proportion of abstracts when the choice is free. Accordingly, time accounts for the smallest proportion of nouns addressed to children (4.3% to one-year-olds, 1.7% to two-year-olds) and it appears that about two-thirds of the object nouns are concrete.

Newport *et al.* (1977) report both more deictic statements ('*This* is your block, *that* one's mine.') and more deictic questions ('Is *that* the other one?') in their subjects' speech to their children and fewer or no such utterances in speech to adults.

Whether there are actually more nouns or pronouns in motherese than in ordinary speech we cannot tell. Ringler reports fewer nouns (25%) and more pronouns (75%) in mothers' speech to their children than in their speech to her (36% and 64%). Remick's data shows fewer pronouns to children (20%) than to adults (25%) but these figures barely miss significance. Both sorts of distribution might be reflected in children's speech, for Nelson (1973) has found that children vary widely in the proportion of pro-forms in their earliest vocabulary.

Other measures are concerned with the referents of personal pronouns. Snow (1972) reports on the proportion of words which are third person pronouns, as it has been noted that English speakers may avoid using the second person in direct address to small children ('We're going to finish our potato now,' or 'David has his new jacket on.'). Surprisingly enough, the proportion is smaller for two-year-olds. Only Wills (1977) has made a detailed study of the assignments of personal pronouns to speakers, hearer and other in parents' speech to their children. Unfortunately, she uses no control corpus addressed to adults in the absence of the child, so that although we know the percent of pronouns addressed to each of five children aged nine to twenty-one months which could be classified as 'baby talk' usage ($\bar{x}$=4.9%) we have no idea whether this frequency is large enough to differ significantly from adultese usage. Remick's classification of personal pronouns used as sentence subjects does shed some light on this question. From her analysis, we can see that 'you' (the listener) is used more often to children ($t=8.58$, $df=7$, $p<.001$), 'you' (impersonal) less often ($t=3.85$, $df=7$, $p=.006$), 'I' (the speaker) less often ($t=11.21$, $df=7$, $p<.001$), and 'she' (the child) less often ($t=12.89$, $df=7$, $p<.001$). While these uses seem to be 'adult' rather than 'baby talk', there are also cases in which mothers used 'we' (false inclusive) and 'we' (editorial) to their children, though no such usage appears in speech to the Experimenter.

VPs. There are differences between speech to children and to adults which involve the morphological and semantic nature of the verbs used, the verb tenses used, and possibly the numbers of auxiliaries used. Not all of these produce obvious predictions about the child's speech.

To study the proportions of weak verbs (those forming the past with '-ed') and strong verbs (so-called irregular verbs) used by mothers, Phillips (1973) checked a dictionary for the etymology of each verb in small samples of mothers' speech. Those which are derived from English verbs are more often strong than those of French or Latin origin. She found that significantly fewer weak verbs and significantly more Old English verbs were addressed to children than to adults. Although strong verbs do have regular patterns, they follow several such patterns (bring, brought; sing, sang, sung; know, knew, known, etc.), as well as some truly unique ones (go, went,gone; be, was, been), rather than the one pattern (dress, dressed, dressed) followed by weak verbs. Hence, *ceteris paribus*, Phillips' finding means that there is less morphological regularity in speech addressed to children learning morphology than in that addressed to adults. Since we know that, after acquiring the first few strong pasts, children master the weak or regular system first (Cazden, 1968), mothers' preference for strong verbs is neither a helpful grammar lesson nor one that is paid much attention.

As one might expect from the findings on concrete nouns, Ringler (1973) reports significantly more action verbs ('go', 'hit', 'build', etc.) in speech to one- and two-year-olds than in speech to adults (83% and 78% vs 56% and 63%). On the other hand percentages of verbs of cognition ('think', 'see', 'know') did not differ significantly.

Our generalizations about the 'immediacy' of motherese should be tempered by Remick's (1971) categorization of verbs by tense. When speaking to their children at home, her informants used on average significantly fewer past tenses (t=2.82, df=7, p=.026) significantly more future tenses (t=5.30, df=7, p=.001), and more, but not significantly more present tenses (t=1.91, df=7, p=.098) than when chatting with her in a laboratory. Given our generalizations and children's apparent preferences for the present, we would not have expected quite these results.

Finally, both Ringler and Remick investigated the number of verbal auxiliaries mothers used. Ringler's informants produced slightly fewer auxiliaries per VP content word when speaking to their children than when answering the Experimenter's questions. Remick's figures for the auxiliaries in declarative clauses yield no significant listener difference. Her results might be consistent with Ringler's if the additional auxiliaries in speech to children appeared in the 'additional' interrogative and imperative sentences (i.e. '*Have* you got it?'; '*Don't* touch that.') which Ringler reports.

IV.A.1.f. Measures of Redundancy

There are two obvious reasons to suppose that redundancy is a desirable characteristic in a message intended for a child. First of all, the child's inability to pay steady attention to speech and to decode it in adult fashion must amount to a noisy transmission channel for language, and redundant messages, in which several parts of the message carry the same information, are the most likely to survive the vicissitudes of such a channel. Redundant utterances, -- repititions and paraphrases, for instance -- , give the child extra chances to attend to the message and to discover what it means. Second, repitition plays an important part in laboratory learning theories. The Law of Exercise, as stated in these theories, predicts that stimuli which are repeated more often are more likely to be learned. Thus, redundant linguistic input ought to improve the child's chances both of interpreting an utterance in context and of being able to interpret similar utterances in the future. But redundancy may bring problems of its own. As we mentioned earlier, Lieberman (1963) proposed that more redundant words are also less clearly pronounced. If his findings apply to maternal speech, the repeated parts of utterances will lose in intelligibility what they gain in redundancy.

Barring this doubt, maternal speech seems to be every bit as redundant as we might wish. Mothers use the same words many times to their children. They repeat or paraphrase their own utterances and provide corrected repititions of the child's.

Type-Token Ratio. Mothers use a smaller vocabulary in speaking to their children than they do in speaking to adults. Phillips (1973), Ringler (1973) and Broen (1972) found a significantly smaller ratio of types (different words) to tokens (total words) in speech by mothers to young children. Remick (1971) using a slightly different measure ((different words)/(2 x total words)[5]), produced figures yielding a mean of 5.66 to children and of 6.82 to adults ($t=3.99$, $df=7$, $p=.005$).

Reiterations of Mothers' Utterances. Several measures of the redundancy of mothers' speech in terms of whole sentence yield significant comparisons.

Snow (1972) found that 14% of maternal utterances in instructions to two—year-olds were paraphrases of earlier maternal utterances, a significantly larger proportion than in speech to ten-year-olds, or in rehearsal for sessions with two-year-olds. For other one- and two-year-old children, but with no specific message to convey, mothers taped by Cross (1975, 1977) paraphrased only about 3 or 4% of their own utterances. Thus the paraphrase rate may have something to do with the urgency of the ongoing communication.

Verbatim repititions of whole and partial sentences have also been tabulated by a number of investigations (Ringler, 1973; Snow, 1972; Newport *et al.*, 1977; Cross, 1975, 1977; Harkness, 1977; Friedlander *et al.*, 1972) though the last three fail to include listeners comparisons. Total repetitions to children are more frequent than repetitions to adults in Ringler's informants, but the effect fails to reach significance in Snow's study. Snow's Subjects did, however, produce significantly more partial repetitions if they were speaking to young children.

Studies not making these addressee comparisons report varying amounts of repetition. Cross (1977) found that 1.3% of full sentences and 28.2% of all utterances were repeated in speech to children. Her 1975 study reports totals of less than 10% in each of the following categories: sentences immediately repeated, sentences repeated after one or more intervening utterances, repetitions of at least a single phrase, repetitions of semantic material transformed in some way and repetitions appearing verbatim in at least two other transcripts (i.e. stock expressions). Other sources for total number of repetitions are Newport *et al.* (1977) with 23% and Friedlander *et al* (1972) with 2.2% for one mother (whose child was producing no recognizable speech) and 29.7% for the other.

Reiteration of Children's Utterances. Brown, Cazden and Bellugi (1964) remarked that in their longitudinal study the most obvious form of parental 'correction' of child syntax was an immediate repetition of all the words of a child's utterance, morphologically corrected and accompanied by such additional words as would yield a complete sentence expressing whatever meaning the parent assumed the child had intended. Thus, Brown *et al.* argue, the child might be given a lesson on his particular syntactic shortcomings before the referent situation had disappeared. This particular form of repetition is known as expansion.

Expansion is hard to find in conversations between adults since adults do not produce the systematic omissions which seem to elicit it. As other reiterations of the interlocutor's utterances (paraphrases and extensions for example) ought to be common enough, it is a pity that there are virtually no comparisons of inter-speaker redundancy in mothers' speech to immature and mature listeners.

In fact, the only comparison seems to be a report in Newport *et al.* (1977) that 6% of mothers' utterances to their young children entirely or partly imitated the child, while no such imitations were made of the speech of an adult listener. No inferential statistic is reported. Figures from other studies (Cross, 1975, 1977; Remick, 1971; Snow *et al.*, 1976; Friedlander *et al.*, 1972) for whole or partial imitations range from 2% (one group of Dutch mothers in Snow *et al.*, and eight American mothers in Remick) to 6.2% (one mother whose normal speech was sampled by Friedlander *et al*).

The same set of studies report that small percentages of mothers' utterances were expansions into complete sentences (0.13 - 7.63%), expansions not forming complete sentences (5.08 - 6.33% in Cross' 1975, 1977), expansions of predicates only (0.6 - .75% Cross), expansions syntactically transformed (1.79 - 3.67% Cross), and expansions elaborating on the original semantic material (1.96 - 3% Cross). Cross (1977), reports that up to 34% of all maternal utterances extend the meaning of child utterances, usually by providing a more detailed form for some NP. While 55% of maternal utterances in Cross (1977) were either expansions or extensions of the child's utterances, Newport (1976) reports only 11% and claims that other studies may include expansions produced for the benefit of the experimenter, as well as those addressed to the child.

Semantically New Utterances. The great amounts of redundancy reported above suggest our asking whether mothers introduce any new material at all in conversations with their children. No listener comparisons are available, but mother-child findings themselves vary extremely widely: Cross (1975) reports 3.52% novel and unique utterances, Cross (1977) 5%, Blount (1972) (on Luo and Samoan speakers) 5% and Newport (1976) 66%.

IV.A.1.g. Specific Language Exercises

Investigations of motherese as a teaching language take special note of the fact that small proportions of mothers' utterances to their children seem to have no purpose other than giving the child practice at language. They may request imitation or repetition, ask the child a question to which both speakers clearly know the answer, or even demand correction of one of the child's utterances. Harkness (1977) reports that language practice of some sort accounts for 6% of parental utterances to twenty two- and three-year-olds in a Kenyan village. Friedlander *et al.* (1972), who time-sampled speech in two American academic households with year-old children, report figures yielding these means: 1.55% of utterances are directed mimicry (Remick, 1971, has 10%); 2.6% overt corrections and 17% prompting. Moerk (1974) discusses such utterances in speech to five American children under five but counts types of interaction rather than utterances. In a later paper (Moerk, 1976), it seems that approximately 15% of maternal utterances to twenty children ages 28 to 60 months elicit or discuss the child's speech.

IV.A.2. The Universality of Adult-Child Speech

If we wish to claim that motherese specifies input necessary to language development, then we must demonstrate that all children who learn language receive such input. With three exceptions (Blount, 1972, Harkness, 1977, and Ringler, 1973) we have so far discussed only the speech of Caucasian, middle-class, English-speaking mothers. Although the children of these women may have received most of their language input from their mothers, we must show that any other person who takes the major responsibility for caring for a child produces speech for which the findings listed above hold true. In section IV.A.2.a, we will comment on the nature of fatherese and on parental qualities in the speech of non-parents. In Section IV.A.2.b, we will offer a catalog of studies reporting similar phenomena across cultures and socio-economic classes.

IV.A.2.a The Speech of Others to Children

IV.A.2.a.i. Fathers

While the original study of fathers' speech to neonates (Rebelsky and Hanks, 1971) found that fathers spent almost no time (37.7 sec/day) talking to infants, all subsequent work defines some verbal role for fathers. Blount's

(1972) study of speech addressed to several Nigerian and Samoan children uses data from their fathers as well as their mothers. It is not clear from his account whether the fathers' speech was indistinguishable from the mothers' or whether he was simply uninterested in distinguishing between them.

A quantitative look at paternal speech is provided by Friedlander, Jacobs, Davis and Wetstone (1972). They placed tape recorders with voice-activated microphones in the homes of two post-graduate couples with year-old children and recorded five of each twenty minutes of each waking hour for a week. The only classification of child-directed speech in which the mother/father differences were in the same direction for both couples were utterances addressed to the child, questions and directed mimicry. In each category there was a larger percentage of maternal than paternal utterances. Other results are reported by Gleason (1975) for a study in which an observer visited each of five couples several times. Although fathers' and mothers' speech were comparable in m.l.u. and mean preverb length and dealt with the same topics, there were some differences. Paternal m.l.u. correlated less strongly than maternal with the m.l.u. of the child addressed. Fathers used more imperative sentences, fewer declaratives, more pejorative terms of address ('dingaling', 'nut', etc.) and more rare lexical items than mothers in speaking to their children. Gleason believes that the peculiarities of fatherese are conditioned by the fathers' social role, rather than by biological factors, because many of these fatherese features are not found in the speech of male day-care teachers (See IV.A.2.a.ii below).

Attempts to explain motherese-fatherese differences return a series of additional hypotheses but all show that the two registers are similar. For example Rondal (1980) recorded five Belgian couples' speaking to their sons aged 18 to 36 months while playing, reading a story or eating a meal. Only in the last case were both parents present at the same session. On some measures fathers' speech differed from mothers' in the direction of adultese, for fathers produced a higher type-token ratio, fewer requests for joint action, fewer corrections, and more requests for clarification than mothers. But in other ways they spoke better motherese than their wives, with fewer declaratives, lower m.l.u. and more attention-getting utterances. As some of the differences depended on the interview condition, fatherese may not be dissimilar to motherese but fathers and mothers may be differently affected by the context of a conversation.

Stoneman and Brody (1981) develop this notion. In their study of the parents of 18 two-year-olds, only the adult(s) present changed across interviews. When both parents were present, fathers deferred to mothers and spoke less to the child, but when alone with their sons, fathers spoke more than mothers. The interplay of linguistic roles may influence the measured characteristics of each parent's speech.

While Horgan and Gullo (1977) collected no speech from parents to children, they tested two hypotheses which were designed to explain why fatherese and motherese are not identical. If experience with children or adherence to a stereotyped female sex-role are preconditions for maternal speech, then each individual's speech to children could be controlled not by his or her genetic sex but by experience and sex-role identity. Forty-one undergraduates roughly balanced for sex and experience with children filled out sex-role questionnaires and then looked at a book with an imaginary two-year-old. Although there was no 'androgynese' for persons of either sex who rejected typical roles, experience did affect pseudo-adult-child speech. Women here produced longer (less motherese-ish!) utterances than men, but over all the measures taken, the sex effect was not significant and reduced steadily in size for individuals with more experience of children. The implication here is that any adult can learn to speak motherese.

IV.A.2.a.ii. Other Speakers

The prevalence of motherese characteristics among non-parents' speech to children is attested in studies on other adults and older children.

Sachs, Brown and Salerno (1976) found parentese adjustments in the speech of nine non-parents to a two-year-old. And Snow (1972) found that non-parents produced a rather diluted parentese when pretending to speak to a child. Gleason (1975) found parentese characteristics in male and female day care teachers and observed that if the number of direct imperatives was anything to go by, the rank order for authoritarian behavior was father-male teacher-mother-female teacher.

More important to the case for a universal register is the ability of older children to make the appropriate adjustments, for many of the world's toddlers spend their time almost exclusively with other children. If the caretaker-companion is the child's next and not very much older sibling (Slobin, 1973; Harkness, 1976), the arrangement guarantees a 'reduced' or simplified linguistic input in which the older child's linguistic development automatically creates a graded corpus for the younger. Brown (1977) notes that the learner's prototypical input may therefore be not paternal, but fraternal speech.

It could be considered an additional advantage, then, that children as young as three have been found to make the familiar sorts of alterations in speech to their juniors. The literature reports short, repetitious 'singing' utterances (Gleason, 1973); reduced use of closed class morphemes, use of present tense for past or future events, avoidance of the the first person pronoun, and imitations of the younger child's mispronounciations (Vasic, unpublished); lower pre-verb length and/or m.l.u., and more imperatives and self repetitions (Sachs and Devin, 1976); fewer, shorter utterances, more attention-getting devices, fewer subordinate clauses, and different uses for the longer sentences (Shatz and Gelman, 1973, 1977; Gelman and Shatz, 1977).

IV.A.2.b. Adult-Child Speech Across Culture and Social Class

IV.A.2.b.i. Cross-Cultural Studies

These studies include evidence that the sort of adult-child speech found among English-speakers has its counterparts in such different countries as Holland (Snow, Arlman-Rupp, Massing, Jobse, Joosten, and Vorster, 1976) and Kenya (Harkness, 1977). Doubt has been expressed about the constancy of conversational roles for parent and child across cultures (Blount, 1972, 1977, for Luo and Samoan speakers) and even about the generality of maternal simplifications (Harkness 1976, for Guatemalan villagers).

But if there are uncertainties about the more recently attested characteristics of speech to young children, there is no question whatever about the universality of the phenomenon called 'baby-talk'. Since long before Noam Chomsky was invented, linguists and anthropologists with an interest in language acquisition have noted that special lexical items, usually defining a variant of the adult phonological system, appear in speech to children. These studies are based on introspection on the part of an author or an adult informant, surveys of dictionaries, or notes taken by an author on striking instances. This methodology cannot tell us whether baby talk lexis or its phonological and syntactic features are particularly common in speech to infants and toddlers, or regularly accompanied by other alterations in speech style, or in any way useful to the child.

What the studies do show us is that baby talk items are found in a wide variety of languages: Algonquin (Chamberlain, 1893), Arabic (Ferguson, 1956), Berber (Bynon, 1968, 1977), Cocopa (Crawford, 1970), Comanche (Casagrande, 1948), English (Ferguson, 1964), Gilyak (Austerlitz, 1956), Greek (Drachman, 1973), Hidatsa (Voegelin and Robinett, 1954), Iroquois (Chamberlain, 1893), Japanese (Fischer, 1970; Chew, 1969), Kannada (Bhat, 1967), Latvian (Ruke-Dravina, 1961, 1977), Maltese (Cassar-Pullicino, 1957), Marathi (Kelkar, 1964), Mohawk (Chamberlain, 1890), Romanian (Avram, 1967) and Spanish (Ferguson, 1964). In addition, mention is made of baby-talk items in French (Bynon, 1968, Ferguson, 1977), Russian (Ruke-Dravina, 1977), and Serbo-Croatian (Vasic, unpublished).

IV.A.2.b.ii. Socio-Economic Class

Given the suggestions made by Bernstein (1970, 1971) as to the difference in modes of social interaction among socio-economic classes in western societies and the findings by Heider *et al.* (1968) and van der Geest *et al.* (1973) indicating a communicative 'deficit' in the lower socio-economic class children, it makes sense to look for characteristics of speech addressed to children which vary with socio-economic class and which may be responsible for later differences in children's behavior.

Whatever deficits there may be, the concomitant differences in maternal speech are fairly trivial. For example, Snow *et al.* (1976) report that only six of their thirty-four measures varied with the social class of Dutch mothers and these did so only in one of the tested conversational settings. A study by Holzman (1974) finds no significant differences between two of the middle class mothers (Brown 1973) and two upper-lower class mothers (Bullowa, Jones, and Duckert, 1964) in the kinds of directives used. Ringler's (1973) work on ten lower socio-economic class speakers of Black English yields figures almost totally concordant with those in studies on other Americans.

In summary, then, the studies of differences among speakers and socio-cultural settings do nothing to discourage the belief that aspects of motherese should be available to any child in regular contact with other members of his community. But the universal presence of a phenomenon is no guarantee of its utility. For evidence of a relationship between adult-child speech and language acquisition, we will have to proceed to our second major question: is this special input linked in any way to the child's linguistic level?

IV.B. The Effect of the Child's Language Development

IV.B.1. The Simple Correlations with Age and Language Development

The many quantitative differences between mother-child and mother-adult speech and the similarity of the former to other speech to young children argue that there is a distinct adult-child register which will normally provide much of the child's linguistic input. Characteriatics of that register will serve as crucial examplars only if they are present in adults' speech at or before the point when the child needs them as grist to his language mill. Though it would be extremely interesting to explore this possibility by predicting from the child's acquisitions at each point the features to be expected in the parents speech at or before that stage, no one, to my knowledge, has had the temerity to do so. Instead, where individual parentese features are found, their utility is inferred *post hoc*. This procedure, if unaccompanied by predictive studies more or less precludes a coherent theory of the role of parentese in first language acquisition. As we shall see below (IV.C.3), a major criticism of motherese work is its incoherence.

Lacking a more detailed set of hypotheses, researchers in this field have devoted considerable effort to establishing that there is a broad, long term relationship between the distinguishing features of motherese and the linguistic development of the child.

There are at least three separate difficulties involved in establishing such correlations. The first is at base a practical one, the choice of a developmental measure. As there is no known measure which is equally and independently sensitive to all recognized aspects of language development, researchers have had to choose among three less than perfect solutions. Knowing that language development correlates positively with age, some have used only chronological age as a measure of that development. But, since age and indices of linguistic development do not correlate perfectly, knowing that some motherese characteristic peaks at two years and three months, for instance, will not tell us whether it always precedes acquisition of plural inflections. Other researchers have used only the child's mean length of utterance in morphemes as a single general measure of linguistic progress. Still others have used a series of measures of individual categories of language behavior. Both solutions might allow important correlations to be missed. While m.l.u. correlates with most other measures (Newport, 1976), it could reflect only weakly some particular sort of linguistic growth which is strongly correlated with a maternal speech characteristic. Alternatively the choice of particular categories of behavior probably implies the omission of others. The combined solution, often chosen for reasons of 'good measure', is even more dangerous. It will be radically better than its parts only if the submeasures are not intercorrelated and therefore can behave independently of each other with respect to maternal speech correlation. To my knowledge, no first order correlations have revealed the required independence among developmental measures[10]. The results of these studies are large correlation matrices with many more significant than informative correlations.

The second major difficulty entailed by this work is not so much practical as logical. The statistics we use are causally opaque. If motherese in some sense causes language development, measures of the two will surely correlate and measures of the former will show changes between two points in time. But if correlations and time t-tests are significant, we cannot conclude that motherese is the cause and language development the effect. The relationship might be the other way round. Indeed, it is another major claim of workers in this field that the mother is sufficiently sensitive to the development of her child's speech to 'tailor' her own to it (Snow, 1977). This in itself is an interesting claim but, even if it is true, will not prove that changes in motherese further the child's development. Of course, motherese change correlating with child language change may have a third implication: that both mother's and child's speech have a strong correlation with some third variable which overwhelms their own minimal relationship. How this might work is the concern of Section IV.C.3. below.

The last problem is more general and has to do with the fact that children have other characteristics than youth and developing language. If characteristics which are irrelevant to language growth can be shown to elicit or control aspects of motherese, the argument that adult-child speech carries the burden of language acquisition weakens appreciably.

IV.B.1.a. Physical Variables

Physical characteristics of motherese change as the child develops, but the rate of change is slower than that for its formal features.

Pitch. The fundamental frequency of mothers' speech to children appears to decrease as the children grow older. Garnica (1977) shows that while mothers of two-year-olds produced a significantly higher F_0 for their children than for adults the difference had all but disappeared among mothers of five-year-olds. Within a much smaller range of ages (16-29 months), Remick's (1971) figures yield only insignificant negative correlations between F_0 and the child's age (r_s=-.28) or his linguistic stage (r_s=-.10)

Intonation. Garnica (1977) found that although the rising terminal pitch did appear significantly more often in speech to two-year-olds than in speech to adults, there was no such increase in the incidence of rising terminal pitch for five-year-old listeners. Whatever motherese pitch and intonation do for intelligibility of speech to children, they have resigned their role by the stage when adult-like processing can be found.

Rate of Speech. In studies where the child's age is the index of development, the rate of speech to the child does increase with his growth but again only over relatively long periods of time.

Of the two groups of words whose duration she measured, Garnica found that only the imperative verbs ceased to be enunciated more slowly for the five-year-olds, while color words were significantly slower when spoken to children of both two and five than to adults. Broen (1972) reports a significant difference in speech rate to children separated in age by at least two years.

Other studies have failed to find significant rate differences over a small age range: for 16-29 months, Remick (1971); and for 18-36 months (Cross, 1979)[11].

A more local measure of speech rate, the number of sentences with two primary or tonic stresses, also shows long range change. Though Garnica found more such sentences in speech to two-year-olds than in speech to adults, once more the difference had disappeared for mothers of five-year-olds.

Pauses. Broen's (1972) and Dale's (1974) data both show that the same mother will pause in different places when speaking with her younger and older child. In Broen's corpus, speech to one- or two-year-olds shows fewer within-sentence and more between-sentence pauses than in their speech to children over four. Dale reports similar results for two- and three-year-olds as opposed to five- and eight-year-olds. He also notes that speech to the younger children had the higher ratio of between-constituent to within-constituent pauses. Apparently, then, maternal hesitations can become less helpful cues to sentence structure over a time span of at least two years.

IV.B.1.b. Amount of Speech

Again there is some evidence of a change over large time spans. While Remick's figures yield insignificant negative correlations between total number of words and age or stage for children from 16-29 months, Snow's (1972) study shows more speech to two than to ten-year-olds in the same task. The presence of the younger child significantly increases the amount of speech his mother produces, with estimated task difficulty a far less important factor.

IV.B.1.c. Measures of Syntactic Complexity

In comparison with the many complexity measures showing adult child differences, relatively few correlate with the child's age and fewer with his linguistic development, particularly for children aged one to three, when the most rapid development is taking place.

M.l.u. Several studies report either a significant positive correlation between the mother's m.l.u. and the child's age or a significant difference between the m.l.u. of utterances to groups of children at different ages. Only two show a strong relationship between mother and child m.l.u.

Some of these studies show differences between speech addressed to two- and three-year-olds but not to one- and two-year olds. Longhurst and Stepanich (1975) recorded conversations in a laboratory playroom between thirty-six mothers and their children of 11-13, 23-25 or 35-37 months. Average maternal m.l.u's for each of the first two groups (3.67, 3.85) differed significantly from that of the mothers of the oldest children (4.70) but not from each other. Phillips (1973) found a similar difference between maternal m.l.u. to 8- or 18-month-olds (3.56, 3.47) and to 28- month-olds (4.01). Finally, though Ringler (1971) failed to find a listener x time effect for the m.l.u. of speech to 12- (2.61) and 24-month-old (3.48) children, she did find the required interaction for median length of utterance.

Two studies of the effects of larger age differencees also yield positive results. Snow (1972) found that mothers of two-year-olds (11.25, 9.65) used shorter utterances than mothers of ten-year-olds (9.84, 6.60) in the same set of instructions and that the decrease of m.l.u. in the child's presence was greater for the younger children. Moerk (1974) reports a fairly constant increase in the length of utterances (counted in syllables) with age of the child for five children whose ages ranged from one to five. Unfortunately he gives no statistics. Bellinger (1980) reports changes over the same age range.

Two studies find relationships between maternal m.l.u. and one or more measures of linguistic development while one finds an age but not a development relationship. Harkness (1977) recorded conversations between thirteen children aged two to three-and-a-half and their mothers and child nursemaids in a Kenyan agrarian village. She found significant correlations for both with child m.l.u. Cross (1977) found that the m.l.u. of the mothers of sixteen verbally advanced Australian children aged 19-32 months correlated positively and significantly with the child's age in weeks, and even more highly with his m.l.u., longest utterance and score on a receptive test. Cross (1979), who may or may not be reanalyzing the same data, also reports significant positive correlations between maternal m.l.u. and additional child production measures. Since her production and comprehension measures must be highly intercorrelated the additional results are less than surprising[12]. On the other hand, Newport *et al.* (1977) found a significant positive correlation between maternal m.l.u. and child age but found no significant correlation between m.l.u. and linguistic development.

Bohannon and Marquis (1977) suggest a reason for the relation of m.l.u. to language development. They found that with two different groups of adults speaking to the same child at 32 and 36 months (m.l.u. 3.59, 3.73), the visitors' shorter utterances elicited more 'comprehending' responses and their utterance length was more likely to fall after a 'non-comprehending' than a 'comprehending' response. Unfortunately, though the child's comprehension rate increased between visits, the average adult m.l.u. did not.

Sentences of more than One Sentoid. A number of researchers have found that mothers produce more multi-clause sentences to older and/or linguistically more mature children.

Three studies report relations between the child's age and the frequency of multi-clause sentences addressed to him. Remick (1971) reports figures for clauses introduced by conjunctions which yield a significant correlation with the child's age (r_s=.67, p=.035). Snow's (1972) study, not surprisingly, reports that the ratio of compound verbs and subordinate clauses (i.e. of complex sentences) to all utterances is by far lower in direct speech to a two-year-old than under any other condition. Phillips (1973) discovered that while the mothers of twenty-eight-month-old boys produced significantly more verbs per utterance than the mothers of either eight- or eighteen-month-old boys, this difference was not found for the mothers of girls.

Two studies report an increase in multi-clause sentences with linguistic development. Cross (1977, 1979) finds a significant positive correlation between the mother's propositions/per utterance and some of the child's receptive and productive measures. Harkness (1977) reports that a measure of verbs per utterance is significantly positively correlated (r=.88) with the m.l.u. of the child.

Modifiers. Phillips (1973) found that more modifiers appeared per utterance addressed to twenty-eight-month-old children than to eighteen- or eight-month-olds. Cross (1979) finds a positive correlation between pre-verb length and age, but none with linguistic measures.

IV.B.1.d. Other Possible Sources of Psycholinguistic Complexity

Fragmentary Utterances. The relationship between the mother's imperfect utterances and the child's development depends on the particular imperfections of the utterance. While verbless utterances, and fluent but fragmentary sentences become rarer as listener age increases, the proportion of truly major breakdowns increases.

The data on verbless utterances comes from Phillips' verbs per utterance measure as quoted above and also from Snow's (1972) comparison between speech to ten- and two-year-olds. The younger children heard more utterances without verbs. The data showing a decrease in sentence fragments with listener age is provided by Cross (1977) and Remick (1971). Both find significant negative correlations between proportion of fragments and listener age.

The frequency of one-word utterances (Cross, 1977) other than replies to yes—no questions shows a significant negative correlation with the child's own type/token ratio but with no other measures of development. It is interesting that estimates of the child's vocabulary are often out of line with other indices of development (see Newport, 1976), and so may be independently informative. It is not implausible that number of citation forms should be related to vocabulary growth.

Increases in 'degraded' utterances with the child addressee's development were found by Cross (1977, 1979) and Broen (1972). Cross reports significant positive correlation between the proportion of maternal utterances which were untranscribable or disfluent and the age of the child. The disfluent class also shows some increase with language development. In free speech, though not in storytelling, older children hear more disfluent sentences (Broen, 1972).

Word Order. Where maternal word order, the proportions of S-V-O and non S-V-O sentences, shows any significant relationship to the child's development, it is along the lines of an increase in S-V-O sentences and a decrease in others. The short-range studies which have produced information on this point, however, have often found no significant change.

Of studies counting declarative sentences, only Newport *et al.* (1977) report a significant positive correlation (r=.51) between the percent of declarative sentences spoken by the mother and the m.l.u. of the child. One mother in Snow (1977b) appears to produce declarative sentences at a rate which correlates positively and significantly with her baby's age, while the other's change is not significant. Ringler (1973), Cross (1977), and Harkness

(1977), all working with age ranges from one to three-and-a-half years, fail to find any significant change with age.

For non-S-V-O sentences, only one study reports a decline with age for each sort, while others fail to find a significant relationship. Newport *et al.* find a correlation of -.58 between the proportion of imperatives in the mother's speech and the child's age. Cross (1977), Ringler (1973), Snow (1977b) and Harkness (1971) find no such relationship. Questions are equally weakly represented: Cross (1977) finds a significant decrease (r= -.52) with age, but with no developmental measures and Ringler (1973), Remick (1971), Longhurst and Stepanich (1975) and Harkness (1977) find no significant relationships. Cross (1977) finds a significant negative correlation between the number of maternal wh-questions and the child's age.

Semantic Roles. One difficulty a child might have in speech processing is grasping the relationships among major sentence constituents. Snow (1977a) reported that mothers in her study tended to restrict the relationships to an even smaller subset of major semantic roles than the child himself seemed to be using at the time. But Retherford, Schwarz and Chapman (1981), in a study of conversations with six girls at 19-24 months and again at 24-28, reported that the distribution of childrn's semantic roles changed over time in the direction of their mothers' usage rather than vice-versa. As their mothers' usage here probably represents the more adult-like pattern toward which the girls were progressing, this result is not remarkable.

IV.B.1.e. Use of Form Classes

Functors and Contentives. There is a very slight tendency for mothers of older children to use more functors and fewer contentives than mothers of younger children in the 8-28 month age range. Phillips (1973) finds this only for the percentage of functors in mothers' speech to 28-month-old girls and 18-month-old girls. Ringler (1973) finds parallel changes in speech to both child and adult between visits.

NPs. The only report of significant change in noun-phrase use with the child's growth is Snow's (1972) finding that mother's of 10-year-olds use slightly but significantly more third person pronouns (6% of all words) than do mothers of two-year-olds (5%).

VPs. There appears to be a tendency for mothers to increase their range of verb tenses in speech to older children. Phillips' (1973) informants produced more verb forms per 40 verbs to 28-month-olds than to 18-month-olds, Remick (1971) reveals a significant increase in the percent of past tense verbs with the child's linguistic stage (r_s=.75, p=.015) and a decrease in present tense verbs (r_s=-.63, p=.049).

Phillips also discovered that more Old English verbs were addressed to girls at 28 months than at 18 months, but the parallel difference for boys did not reach significance.

IV.B.1.f. Measures of Redundancy

Type-Token ratio. While there is still some evidence that maternal vocabulary increases with the child's age or language growth, this finding is not universal. The studies which yield significant type-token age relationships are Phillips (1973) (a difference between mothers of 18- and 28-month-old children) and Remick (1971) (for types/(2 x tokens)$^{.5}$ and age, r_s=.64, p=.043). Remick's figures show a similar correlation with linguistic stage (r_s=.63, p=.049)[13]. Both Ringler (1973), using types/tokens, and Longhurst and Stepanich (1975), using Remick's measure, found no significant difference between speech to one- and two-year-olds, or in the latter study to two- and three-year-olds.

Reiteration of Mothers' Utterances. Nearly all measures of the redundancy of maternal speech on the sentence level show significant decreases with the child's age or with some measure of his linguistic development.

The number of times a mother paraphrases herself has been shown to decrease with age and with assorted developmental indices (Snow, 1972; Cross, 1977, 1979). The mother less often repeats her own utterances verbatim as her child develops (Newport *et al.*. 1977; Cross, 1977, 1979). Harkness (1977) found a similar negative correlation with the m.l.u. of Kenyan village children.

Analogous results are found for subcategories of repetition. Cross (1977) and Snow (1972) both found that repetitions of one or more phrases decrease in frequency with time. Cross also showed that they decrease as receptive scores, m.l.u., and comprehensibility increase. Repetitions which are transformed in some way and stock expressions (identical repetitions made by more than two mothers) also fall as various measures of development rise. Repetitions of whole sentences are rarer in speech to older children (Ringler, 1973; Snow, 1972).

Reiteration of Children's Utterances. The data in this area lead to no firm conclusion. Cross (1977, 1979) repeatedly reports negative correlations between mothers' repetitions of their children's utterances and the age or linguistic development of the child, while other researchers find that only the occasional positive correlation is significant.

The data on mothers' verbatim imitations of children's utterances is confusing. Remick's (1971) figures yield a significant negative correlation with m.l.u. (r_s=-.69, p=.028) and with age (r_s=-.61, p=.054). Moerk (1974), claims on the basis of figures he does not quote, to have found a positive correlation between age and a composite category including imitations, while Cross finds no significant relationships with imitations.

The tendency for mothers to expand their children's utterances also produces different results in different studies. Measures of complete expansions may increase significantly with the child's estimated vocabulary and m.l.u. ($r=.79$, $r=.88$) (Newport *et al.*, 1977) decrease with all measures ($-.85<r<-.65$) (Cross, 1977), or increase significantly with age ($r_s=.31$) and m.l.u. ($r_s=.22$) (Remick, 1971). The percentage of incomplete expansions increases with m.l.u. in Newport's (1976) study and decreases significantly with all measures taken by Cross (1977).

Data from other subcategories and intersecting categories in this area are entirely due to Cross (1977). She reports that semantically elaborated expansions decrease significantly with all measures and that syntactically transformed expansions decrease as the child's upper bound grows, while pronoun extensions significantly increase with the child's upper bound. As that last is the only positive correlation which Cross reports it is not surprising that she finds that intersecting categories (expansions + NP extensions, expansions with repetition, extensions with repetition) correlate negatively with all developmental measures.

Contextual Redundancy. There is some indication that mothers expect that over time children will be able to pay more attention to the linguistic and less to the extra-linguistic contexts of utterances. Bellinger (1980) reports an increase over child age in the number of maternal utterances which cannot be properly understood without reference to materials in previous utterances, and an increase in those which refer to objects which are not present at the time. Similarly, Cross (1979) finds significant positive correlations between 'non-immediate' references and age or language development and

Snow (1977b) finds references to the child's or joint activities decreasing from three to eighteen months.

IV.B.1.g. Specific Language Exercises

Utterances which have been classified as clearly intended to provide language exercises decrease with increasing age and development. Harkness (1977) reports a significant decrease in utterances which she calls language practice with increasing m.l.u. Remick (1971) and Moerk (1974) both counted utterances that seemed to be intended as models for the child to repeat. Remick's figures yield significant negative correlations with age (r_s=-.93, p=.001) and m.l.u. (r_s=-.81, p=.007). Moerk's graph shows a non-linear decrease in modelling as in overt correction and prompting with age. No correlations are cited.

IV.B.2. Other Elicitors of Adult-Child Speech

Table 2.1 (see section IV.D.1) lists all those features of mothers' speech which show significant addressee effects (as well as a few others for which some difference might be assumed). More variables were put to the correlation test, but the direction of the original addressee difference provides a check on indiscriminate interest in the correlations by predicting the sign of r or r_s. Where the value of a measure was less in parentese (<), the r with language development should be positive. If parentese showed more of some feature (>), r should be negative. We will deal with the table in its entirety later, but for now several facts are worth noting. Fewer measures show significant correlations with age than show adult/child differences, and fewer still have been demonstrated to correlate with any measure of language development. Also, while the sign of the age correlation is usually correct, the sign of the language correlation does not always agree. And finally, in 13 of the 42 cases, studies disagree on the sign or significance of a correlation. The profile of results might make us somewhat reluctant to nominate language development as the elicitor of parentese.

Other suggestions are readily provided. Noting that utterances to prelinguistic infants are also short and repetitive, Kaye (1980) asks why we should imagine that these features are elicited by the two-year-old's particular receptive abilities. And as there is more repetition in speech to uncomprehending infants, he asks why we should suppose that repetition is designed to enhance comprehension or to be instructive. His detailed arguments meet with some difficulty in view of the repeated finding that there is a discontinuity in mothers' speech to infants when or just before they produce their first word (Snow, 1977b; Lord, 1975; Sherrod *et al.*, 1978), but his general point, that bursts of speech may be entrained to the child's burst of activity is not unreasonable.

Another possibility is found in the work of Ringler *et al.* (1975). This study observed differences between the speech of mothers given extra postnatal contact with their infants and controls who followed the usual hospital regime, but the differences were observed two years after the experimental manipulation. It would be unfortunate for what Cross (1975, 1977) calls 'the fine tuning hypothesis' if a child's linguistic input depended not on his language development but on the hospital where he was born.

Even more disquieting are the findings of Hirsch-Pasek and Trieman (1982). They compared four women's speech to an adult and to their dogs. 'Doggerel' had significantly fewer declaratives, shorter utterances, and more questions and imperatives than adultese. The authors note the diminutives, phonological deformations and pitch characteristics frequently noted in parentese. Only in a shortage of deixis does doggerel fail to emulate motherese. Unless we assume that the informants had delusions about talking e use Unless we assume that the informants had delusions about talking animals, we must come to a conclusion similar to the experimenters': either the component of motherese which is controlled by affection for the addressee (Brown, 1977) includes parameters previously thought to be linked to developmental stage or the whole register can be elicited by a minimal amount of social responsiveness.

It might be wise to conclude that although motherese does change with age and language development, it can be elicited or controlled by variables which have little to do with either. The primacy of the relationship between mother's and child's speech must therefore be in doubt. It receives little support from Table 2.1 and less from the studies suggesting the influence of factors largely irrelevant to language acquisition.

IV.C. Attempts to Find Effects of Adult-Child Speech on Language Development

IV.C.1. Deprivation Studies

If adult-child speech really does make language acquisition possible for the child, any individuals who happen to lack the register as input should largely fail to acquire language. Data from three studies of accidental deprivation of this sort do not fulfil this prediction as far as one might wish.

The most dramatic example is the case of the girl called Genie (Curtiss, 1977), who spent most of the first thirteen years of her life tied down and alone, seldom spoken to, and punished for vocalizing. When she was first brought to a hospital for rehabilitation, she had no spoken language and appeared to comprehend only a few isolated words. We have no direct report on adult speech to Genie but Brown (1977) supposes that medical personnel who worked with Genie may have slowed and clarified their speech to her.

Susan Curtiss, who studied Genie's language, developed such a close bond with the girl and spent so much time with her that it would be surprising if she did not use at least some of the features of parentese. Still, after five years of constant attention and great social and emotional progress, Genie continued to show a real, though by no means total, language deficit. Her case will not tell us whether parentese is vital because we do not know whether to attribute her linguistic handicap to a lack of parentese *per se*, to its late arrival in her life, to the impossibility of producing some of its vital features when addressing an adolescent, or to her general environmental and emotional deprivations.

Less tragic are the studies of the hearing children of deaf parents. Sachs and Johnson (1976) described the case of a child called Jim whose parents had insufficient command of spoken language and insufficient faith in the value of sign to address much of either to him. On the basis of input from television and play sessions with other children, he could at 45 months carry on a conversation with an interviewer, answering questions and keeping to the topics the interviewer designated. On the other hand, his m.l.u. was only 3.00, his use of word order was very strange, and his intonation was monotone. As soon as Jim entered a nursery school where teachers took care to speak to him, his intonation began to change and within a year his speech was reported as normal. It is possible to see Jim's case as showing that the basic material of linguistic communication can be derived from any long term contact with language, while details like inflections, word order and intonation require a certain amount of personalized attention, a suggestion which we will find in Newport *et al* (1977).

Five more hearing children of signing parents were studied by Schiff (1979) in separate conversation with mother and Experimenter over four to six months. Three of the mothers were less than 15% intelligible and the children's normal linguistic input came only from two hours of television a day and five to ten hours contact with normal adults per week. Nonetheless all five two-year-olds were within normal developmental range for their age. Their ranking in proportions of obligatory morphemes correct correlated .87 with the order reported by deVilliers and deVilliers (1973) for children with normal linguistic input reaching the 90% criterion on any of the 14 morphemes considered. As such abnormal input creates such normal output, these findings surely encourage the belief that motherese is beside the point.

IV.C.2. Intervention Studies

The evidence presented by intervention studies is also not compelling. The experiments in question all deal with expansions of children's utterances. Brown and Bellugi (1964) first noted the frequency with which parents repeated their children's utterances, filling the gaps left by the child's incomplete command of English syntax. The difference between expansions and the utterances they expanded consisted precisely of those bits of the language which the child ostensibly did not know. Furthermore both utterances in a pair were produced in a context in which they made sense and during the short time when the child's attention was focussed on their content. Under these circumstances, Brown and Bellugi conjectured, expansions might provide ideal language lessons. It remained to be seen, however, whether one could effectively tutor a child in language merely by expanding his utterances unusually often.

The first experiment on these lines was Cazden's (1965) study of twelve Black children initially ranging in age from 28 to 38 months. All normally spent at least eight hours a day in a day care center with thirty other children and no more than two adults. For forty minutes a day, five days a week, for twelve weeks, four of the children were alone with a speaker of Standard American English who expanded each utterance they produced. For a similar period another four children had a speaker of Standard English read to them from a picture book, thereby producing new model utterances without ever expanding anything a child said. The four control Subjects received no treatment other than an occasional visit to the room where the other two conditions were administered. Comparison of pre- and post-test scores on a number of measures of language production showed no significant treatment differences. Only the ranking of differences between total pre- and post-test scores suggested that not expanding but modelling led to the greatest gain[14].

A second study (Feldman, 1971) dealt with twenty-four children aged 30 to 46 months. In one thirty-minute session a week for twelve weeks, eight of the children had all their utterances expanded. For a second group of eight, all utterances which the Experimenter understood clearly were expanded, while for a third group, no utterances were expanded, but complete new sentences were produced. At the end of the training period, an imitation test showed no significant treatment effects.

The third attempt to manipulate extensions was made by Nelson, Carskaddon and Bonvillian in 1973. They provided two twenty-minute training sessions a week for eleven weeks, in which nine children aged 32 to 40 months had all their complete sentences paraphrased and their incomplete sentences expanded and nine others were replied to in sentences which did not contain any of the content words of their own previous utterances. A third group of nine received no treatment. The new sentence group did not show any more progress on production tests than the controls. The group whose utterances had been expanded or paraphrased, however, showed more progress than either of the other two groups.

Thus while Feldman's study shows no effect for expansions and Cazden's finds them apparently less useful than new sentences, Nelson *et al.* conclude that expansions are more conducive to progress than new sentences. Deciding among these studies is not at all easy. Perhaps any intervention experiment running for only three months of a three year process might be expected to yield less than overwhelming results. Taken with the findings of Newport *et al.*. (1977), who showed only an expansion/VP inflection relationship in somewhat younger children, the expansion studies still have to be read as disappointing Brown's and Bellugi's high expectations.

IV. C. 3. Observational Studies

A third approach to casual relations between adult-child speech and language development studies the progress made by different children over the same time span in hope of finding that variance in some motherese characteristics at the start of the study (time x) will be associated with variance in the child's progress from x to x'. The difficulty with this approach, on which four studies are directly or indirectly based, is that they suffer either from an artefact which tends to magnify the parentese-progress relationship or from an artefact which hides it from view.

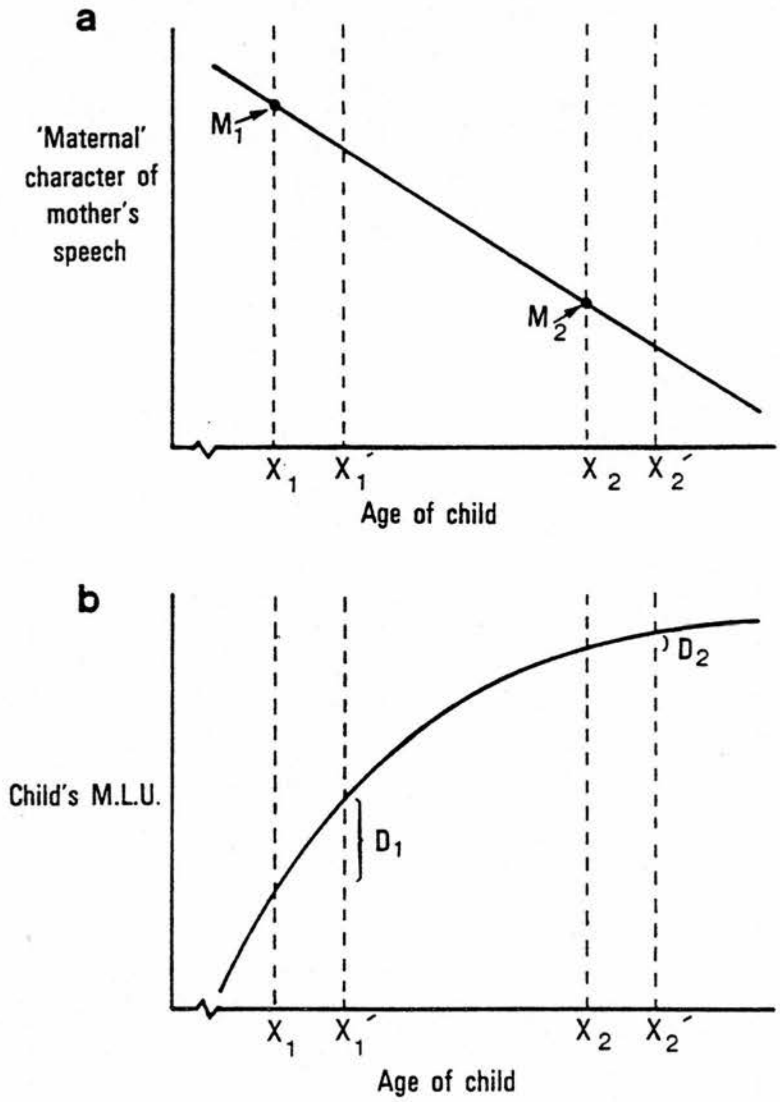
The first is described by Newport, Gleitman, and Gleitman (1977). They point out that an artefact is to be predicted from the fact that both the character of the mother's speech and the m.l.u. of her child correlate with the child's age. As we have seen, sundry characteristics of mothers' speech to children change with the age of the child. Whether our counts show frequencies increasing or decreasing, what is supposed to be happening in cases of dependable correlations is that the peculiarly maternal character of the speech is gradually returning to a level typical of speech among adults. Thus, if we think of speech to very small children as having highly 'maternal' characteristics, we can say that such characteristics correlate inversely with the age of the child. Figure 2.1a shows this relationship idealized in a simple form. Compare this to Figure 2.1b, which shows an idealized relationship between the child's m.l.u. and his age. Newport *et al.* suppose, and there seems to be no serious evidence to the contrary, that m.l.u. follows the standard decelerating curve which is common to the acquisition of many behaviors. Simply because progress is faster earlier in the course of development than it is later, the child's progress over a given time span will depend on his position on an m.l.u. curve: compare the increase in m.l.u. for a less advanced child (x_1-x_1') and a more advanced child (x_2-x_2') in Figure 2.1b. As the motherese curve in Figure 2.1a. is higher at x_1 than at x_2, we will automatically find a positive correlation between motherese and development -- even if the two have no casual relationship whatever.

The way to solve this problem is to eliminate from the picture the relationships with the child's age and with the inconveniently decelerating m.l.u. curve. Newport *et al.* did this by taking progress data on children of three ages and computing MS x progress correlations with both m.l.u. and age statistically partialled out, in effect reducing the ages of the children to a single age and their m.l.u's to a single m.l.u. What is left is the residual variance of the motherese characteristics and of the child's linguistic growth.

A finer grained approach to the same problem is taken by Furrow, Nelson and Benedict (1979). Reasoning that input features which are more important at one stage in linguistic development may be irrelevant later or earlier, they criticize Newport *et al.* for potentially cancelling these specific effects by studying children of different ages. Instead Furrow *et al.* did their

FIGURE 2.1

The Idealized Relationships Between Maternal Speech and Child Age and Between M.l.u. and Child Age. (See text for further explanation).



double partialling by studying the progress over nine months of children who really did have the same age (18 months) and m.l.u. (1.00-1.40) at the start of the study. In the light of Bohannon and Marquis' (1977) finding that the child's comprehension may control the parent's speech, it is unfortunate that these children differed in receptive ability at 18 months. The fact that these children's receptive scores correlated well both with motherese at 18 months and their own subsequent progress particularly weakens the authors' arguments.

These studies can be done only if it is possible to retest all children after the same interval. Progress is then computed as some sort of difference between their scoes at x and x'[15]. When only one sampling point is available, however, other designs are adopted. Harkness (1977) correlated motherese characteristics with child m.l.u. at a single time while statistically partialling out the age of the child. This design may or may not produce information about the results of MS but it certainly describes more accurately than others the correlation between MS and child m.l.u. On the other hand Cross (1975) matched pairs of children by m.l.u. but not by age. She then compared characteristics of speech to the older children in all pairs with speech to the younger, reasoning that whatever is greater in speech to the younger may be responsible for their precocity. Notice that while Cross' results may indeed reflect the causal relation she is looking for, they are subject to an artefact similar to that described by Newport *et al.* Wherever there is a motherese characteristic that decreases with age, the younger child ought to have more of it. Just as Harkness' findings may show only the MS-m.l.u. correlation, Cross' results may reflect no more than the relationship between MS and age when m.l.u. is held constant.

The other major problem in this area appears when this partialling is done. All the variables at issue are highly inter-correlated. Motherese has been shown to change with child age and/or m.l.u., while m.l.u. changes with age and progress rate changes with both. As so much of the variance of each is shared with the others, partialling m.l.u. from correlations with age, age from correlations with m.l.u. or both from correlations with progress will leave very little variance to be described. In general, multiple correlation and regression techniques are not recommended for use with highly inter-correlated (multicollinear) variables (Cohen and Cohen, 1975). At least their results must be treated with caution for reasons that will soon become apparent.

The first of these will delight the tired reader: though the higher order correlations with motherese features are logically more legitimate, the loss of shared variance makes them very few. Once more Table 2.1 provides a partial summary.

IV.C.3.a. Measures of Syntactic Complexity[16]

M.L.U. Maternal m.l.u. has been found to correlate positively ($r=.71$, $p<.01$) with the m.l.u. of the child addressed (Harkness, 1977) but to have no obvious relationship with the child's age (Cross, 1975). Newport *et al.* (1977) report no significant progress correlations but Furrow *et al.* (1979) find significant negative correlations with several developmental measures.

Sentences of More than One Sentoid. Various comparable measures of the number of S-nodes per utterance have performed similarly to m.l.u. Harkness found that the number of verbs per utterance in the speech of Kokwet mothers to their children correlated +.76 ($p<.01$) with the child's m.l.u. adjusted for age. Cross found no significant difference between the number of propositions per utterance to older and younger children matched for m.l.u., and neither Furrow *et al.* nor Newport *et al.* discovered any significant correlation between S-nodes per maternal utterance and linguistic progress with the children's age and m.l.u. partialled out. In view of these findings, it seems that mothers increase the complexity of their utterances as their children develop linguistically without thereby contributing sizably towards that development.

IV.C.3.b. Use of Form Classes

Only Furrow *et al.* report significant correlations with progress here. The numbers of pronouns correlated negatively and so the noun to pronoun ratio correlated positively with child m.l.u. ($r=-.75$, $p<.05$; $r=.72$, $p<.05$) and verbs per utterance ($r=-.81$, $p<.025$; $r=.74$, $p<.05$). The numbers of verbs (including main, auxiliary and copular verbs) correlated negatively with the same measures ($r=-.71$, $p<.05$; $r=-.78$, $p<.025$), probably because their subset, the copulas, showed these relationships ($r=-.85$, $r=-.90$, $p<.025$) as well as a correlation with nouns per utterance ($r=-.77$, $p<.025$). The authors ascribe both findings principally to the harmful effects of diminishing the concreteness of speech to 18-month-old children: pronouns and verbs are less concrete than nouns, copulas than other verbs. If so, one wonders why concreteness was not an issue for the subjects in Newport *et al.*, whose mean age was about 19 months.

IV.C.3.c. Measures of Psycholinguistic Complexity

Ease of Segmentation. Cross (1975) found fewer unintelligible utterances addressed to younger than to older children of the same m.l.u. Although she might like to conclude from this that intelligibility of input enhances language acquisition, Newport *et al.* found no significant correlation between their measure of untranscribable utterances and linguistic progress. It might be more reasonable to predict that while adults find mothers' speech to younger children easier to perceive, children may not notice the difference.

Word Order. Though researchers originally became interested in the distribution of sentence types because they expected S-V-O sentences to be particularly helpful input to the child and non S-V-O sentences to be counterproductive, the findings indicate that this was not the proper distinction. Newport *et al.* (1977) show that the results make much more sense if individual sentence types are viewed as examples of specific morphological points.

In English, questions may follow canonical S-V-O order ('What made that noise?') but most sorts do not (Aux-S-V-(O): 'Did Daddy see that?'; O-Aux-S-V: 'What have you done?'; etc.). In Cross' (1975) study, neither the whole set of questions nor any subclass differed in frequency between older and younger addressees. Harkness (whose informants spoke a language which has canonical word order in questions) found a positive correlation (r=+.51) between maternal questions and adjusted child m.l.u. Interestingly enough, Newport *et al.* found that of all questions, only yes-no questions (Aux-S-V-(O)) show significant or nearly significant correlations with measures of the child's progress (with m.l.u., r=+.50, p<.08, and with the increase in the number of auxiliaries in the child's VP, r=+.88, p<.001). In English, only yes-no questions must begin with a verbal auxiliary. As these questions were the only ones to show a positive correlation with the child's subsequent use of auxiliaries, one might wish to conclude with Newport and her colleagues that a sentence starting with Aux is a salient example of auxiliary form and use. Unfortunately, however, Furrow *et al.* report a positive correlation between auxiliaries per VP and yes/no questions which do *not* begin with Aux (r=+.72, p<.05).

While Cross reports no significant child age difference in the frequency of deictic sentences (Deictic-Copula-NP) in mothers' speech, Newport *et al* find a correlation of +.58 (p<.05) between deixis and increase in the number of inflections in the child's NP. Again they conclude that progress occurs because the relevant sentences provide the examples necessary for learning: deictic sentences contain little but NPs.

Though neither Harkness nor Cross finds significant results for imperatives in MS, Newport *et al.* have discovered negative correlations for affirmative imperatives with growth in auxiliaries per VP (r=-.52, p<.08). Imperatives, of course, will not have initial NPs unless the addressee is named ('Becky, put the pot down'), and have no verbal auxiliaries if affirmative ('Sit down'). By Newport *et al.*'s reasoning, affirmative imperatives not only fail to provide examples of auxiliaries and NPs, they 'drive out' sentences that do. Furrow *et al.* once more upset the applecart. None of their correlations with number of imperatives even approaches significance.

Fragments and Interjections. The number of incomplete sentences of these sorts correlated positively with developmental indices yielding a significant r (+.67) with verbs per utterance in Furrow *et al.* The only explanation offered was that their brevity made for simplicity, in contrast with the view that canonical sentences are simple stimuli.

IV.C.3.d. Measures of Redundancy

Mothers' Reiteration of Their Own Utterances. Although Cross and Harkness had no significant findings for mothers' repititions of their own whole utterances, Newport *et al.* found negative correlations between these and increase in auxiliaries per VP (r=-.58, p<.05), inflections per NP (r=-.51, p<.08), and m.l.u. (r=-.50, p<.08). Cross, however, discovered more repetitions of phrases (rather than whole utterances) and fewer semantically new utterances were addressed to the younger than to the older children at a given m.l.u. If Cross is correct in supposing that the characteristics of speech to the younger group are those which accelerate progress, her findings are in direct conflict with Newport *et al.* If we consider Cross' study to be dealing with age differences, however, the two results sit better together: more phrases are repeated to younger children in general, but repetition is not necessarily helpful.

Mothers' Reiteration of Children's Utterances. While Cross and Newport *et al.* failed to find any effects for mothers' verbatim repetitions of their children's utterances, Harkness reports that a composite category ('expansions and echoes') correlates negatively ($r=-.56$, $p<.05$) with m.l.u. adjusted for age. Cross' study revealed that all repetitions, all expansions and many subcategories of both are produced less often to older than to younger children. Thus maternal repetitions and expansions may decline with both increasing age and with increasing linguistic development.

Newport *et al.* found that expansions correlate ($r=+.51$, $p<.08$) with the increase in auxiliaries per VP. The primacy effect mentioned earlier will not account for this correlation. Instead, the researchers propose that children learn auxiliaries from expansions of their own VPs because, provided the mother expands correctly, the child is actually attending to the situation referred to as the expansion is produced. If we suppose, they say, that children learn pieces of language when they are paired with situations already being attended to, then expansions are a perfect way to teach auxiliaries. Again questions arise. Why are expansions not a good way to teach the NP inflections they contain? And again, what determines whether the primacy effect or the obvious-referent effect takes precedence? And why is it not always possible to find effects for expansions in intervention studies?

IV.C.3.e. An Incoherent Picture

We remarked earlier that one result of partialling highly intercorrelated measures from each other is to reduce the chances of finding any significant correlations even if true correlations do exist. The significant findings can easily be sprinkled over the correlation matrices in ways less suggestive of pattern than of noise.

The chances of producing informative results are even further diminished by the widespread use of interrelated maternal speech measures and equally interrelated child speech measures. Furrow *et al.* confess to the high intercorrelations for the latter: the lowest r-value among pairs of the four child measures is +.60, the average +.78. High intercorrelations are ensured for MS measures by the use of variables which are sums or ratios of other variables. Intersecting categories (eg. reduced imitations and pronouns) produce yet more interrelatedness. In Furrow *et al.*'s Table 4, for example, the use of redundant variables means that the matrix of four child by fifteen maternal measures may be no more informative than a matrix of two by ten. Since the larger matrix is used it almost certainly has a higher ratio of significant than true correlations: it allows so many chances for the same real correlation to be reflected in statistically related measures.

Given the low probability that correlations will survive the partialling process and a high probability that they will be spurious, we would expect a bizarre set of results. I would contend that this is what we find and that the artefactual nature of the outcome is indicated by the frequent disagreements across studies and the incoherence of the explanations offered for the 'causal' relationships.

For example, we have seen that Newport *et al.* propose that children have a processing strategy amounting to 'concentrate on what comes first'. If children's memory does show a primacy effect, the positive correlation of progress in auxiliaries with yes-no questions and the negative with imperatives may be easily explained. But why, then, do researchers suppose that deictic sentences exert an influence through their *final* NP constituents? Why do children acquire suffixes more readily than prefixes (Slobin, 1972) and why do their spontaneous imitations of adult speech include the ends rather than the beginnings of the sentences they echo (Gurman, 1972)? These data argue the importance of a recency, rather than a primacy effect. One might propose that children are subject to both, but this would destroy the neatness of the findings on questions and imperatives. There is no obvious reason why the beginnings of some sentences and the ends of others, but none of still others (statements show no significant correlation with progress) are so important.

Furrow *et al.* also come to grief while attempting to explain their results. Contractions and pronouns are proposed to be difficult on grounds of loss of syntactic, semantic, and phonological information. But the child's command of auxiliary verbs is supposed to be *furthered* by non-canonical yes-no questions which lack auxiliaries altogether (eg. 'getting up?', 'a green one?'). Where information was helpful, its absence is now crucial. These proposals sit so uncomfortably with each other that their conflict with Newport *et al.* is scarcely worth considering. It is probably also profitless to examine Furrow *et al.*'s preoccupation with simplicity in the light of suggestions that one-word children are relatively unperturbed by very lengthy forms of directives (Shatz, 1978a).

These so-called explanations look much like conscientious attempts to make the best of a bad job. Rather than letting extemely dubious data drive our theories of the role of motherese beyond the brink of silliness, it might be better to conclude that the existing data cannot allow us to distinguish potentially causal from totally artefactual relationships.

IV.D. Motherese - Shmotherese

IV.D.1. A Cold Look at a Warm Register

The original reason for studying adult-child speech was to determine whether it simplifies the apparently difficult task of mastering a first language or whether it is of no more practical use than Chomsky (1965, 1975) supposed. Armed with the findings reviewed in Sections IV. A-C, we can now return to this issue.

Let us return to Table 2.1 for a summary of the major results. This review paints a more pessimistic picture than is usual in the literature because it does not give the case for motherese the benefit of the doubt. Only those variables with attested addressee effects are included. Failures to reach significance or to replicate other studies are indicated. And the bias toward finding more correlations with language development than with age is eliminated because one, and only one, child language correlation is listed for each MS variable, regardless of the number of intercorrelating developmental variables used in the research. The results look sparser as we move from left to right.

First of all, it is clearly established that there is a special register used by adults to language learning children. At least forty separate characteristics of mother-child speech have been shown to differ quantitatively or qualitatively from their counterparts in mother-adult speech. Some of these

TABLE 2.1

Principal Findings on Adult-Child Speech [a]

	Addressee Effect: Child/ Adult	First Order Correlations: With Age	First Order Correlations: With language Development	High Order Correlations: x Age	High Order Correlations: Language Development	High Order Correlations: x Progress
1. Pitch (F_o)	>	-*				
2. Pitch range	>					
3. Rising terminals	>	-				
4. Speech rate	<	+*	n.s.			
5. Double primary stress	>	-				
6. Wordsper task [b]	>	-			-	
7. M.l.u.	<	+	+*		+	-
8. Sentoids/sentence	<	+*	+*		+	n.s.
9. Modifers/utterance	<	+				
10. Verbs/utterance	<	+	+			-
11. Major disfluencies + unintelligible utterances	<	+	+	+		n.s.
12. S-V-O sentences	<	+*	n.s.			n.s.
13. Imperatives	>	-*	+	n.s.		-*
14. Questions	>	-*	n.s.	n.s.	+	+
15. Interjections	>		-			n.s.
16. Deictic sentences	>			n.s.		+
17. Optional movement	<					
18. Functors/contentives	<	+*				
19. Concreteness of Ns	>					
20. Ns as actor	>					
21. Ns as place	>					

TABLE 2.1 (continued)

Property	Addressee Effect: Child/Adult	First Order Correlations: With Age	First Order Correlations: With language Development	High Order Correlations: x Age	High Order Correlations: Language Development	High Order Correlations: x Progress
22. Ns as object	<					
23. Ns as time	<					
24. Pronouns	<*	+	+			–
25. Third person pronouns [b]	<	+				
26. False *we* inclusive	>					
27. Vforms/40 Vs	<	+				
28. Weak Vs	<	–				
29. Action Vs	>					
30. Past tense Vs	<	+	} +			} n.s.
31. Future tense Vs	>					
32. Auxiliary Vs	<*					
33. Type-token ratio	<	+*				
34. Self-paraphrase	>	–	–			
35. Self-repetition	>	–	–	–	n.s.	–
(36. Semantically novel utterances	<)			+		
(37. Imitation of addressee	>)	–	–*	n.s.	–	n.s.
(38. Expansion of addressee	>)	–*	+*	–		+
(39. Specific language exercises	>)	–	–			
(40. Absent referent	<)	+				

a Findings which are significant at or about the .05 level are listed. Properties or adult-child speech for which no comparisons are made with adult-adult speech as listed in parentheses. ['+' denotes a positive correlation, '-' a negative, '*' the existence of at least one other study disagreeing with this results, 'n.s.' a correlation not significant at p<.05.]

b Addressee and age effects are a single finding (Snow, 1972), a comparison of speech to two- and ten-year-olds.

characteristics are found in the speech of fathers, of other adults and even of older children in a number of social and linguistic environments. In addition, special baby talk lexis is used to some extent in all societies investigated. So far as we know, then, every small child will be addressed in an adult-child register.

The only fly in the ointment here is that while modifications made by adults often are of significant size, they may not aim toward particular target values. Comparisons based on the summarized accounts of m.l.u. and words per minute, for example, reveal that inter-study or inter-speaker variability can overwhelm the differences due to addressee age. Consequently, the evidence is open to the interpretation that adults alter their speech without restricting their goals to a narrow area such as might be defined by the child's limited perceptual abilities. Whatever it is that determines the adult's behavior in these cases, it is not likely to be the child's real capacities.

Second, some features of adult-child speech show correlations with the growth of the child, but these are fewer than those showing adult/child differences (26 vs 40). Moreover one is in the wrong direction for the adult-child difference (If motherese has fewer weak verbs than adultese, they should increase, not decrease, with age), and there are nine failures to replicate the sign or significance of a finding. As was argued earlier, if these gradual or fine adjustments (Newport, 1976) provide particular features at particular stages in language development, the adjustments must be linked specifically to language growth. But this does not seem to be the case in the published data. Of the twenty-six correlations with age, only thirteen hold for measures of linguistic development, with two wrong signs, two failures of significance and four failures to replicate. Of course some studies deal only with the child's age and cannot show results for language development, but several papers make use of both measures. On the face of it, at least, motherese is not fully sensitive to linguistic growth. As the studies in Section IV.B.2 suggested, motherese may be just as sensitive to other characteristics of an addressee.

In higher order correlations, there is even less to report. For age with m.l.u. held constant (Cross, 1977), there are four significant results and four failures to reach significance. For m.l.u. with age partialled out (Harkness, 1977) there are five significant correlations, one of which has the wrong sign, and one failure. By the time original age and m.l.u. are partialled out of progress scores, we have eight significant correlations of which two now have the wrong sign (If there are more imperatives and self repetitions in motherese than adultese, these features should have positive correlations with progress.)

Recalling that the actual pattern of results is neither orderly nor plausibly explained, we can conclude that the correlations between mothers' speech and child's subsequent progress are at best dubious. Adding the inconclusive character of the intervention and deprivation studies, we must surely tend toward the view that there is no convincing evidence for a causal or facilitative relationship between parentese and language development.

Repelled by this black view, many researchers have offered to brighten the atmosphere. The constant interplay of facilitation and fine tuning (Cross, 1979) or the specificity of useful input to particular linguistic stages (Furrow *et al.*, 1979) may be responsible for our failure to find grosser effects. But without a finer theory of language development and a better statistical method, we will never know. Children may be encouraged to attend to language by the affectional component of parental speech (Brown, 1977; Ferguson, 1977), though paradoxically they may have to examine adult-adult conversations for useful examples of word forms (Shockey and Bond, 1980).

Or as Newport *et al.* (1977) and Brown (1977) suggest, semantic development may be internally powered to the point where the things to be expressed show no strong environmental influence. But the language-specific means of expression may be learned from adult exemplars. This notion is supported by Newport *et al.*'s study, where only the development of functors correlates with MS variables, but there is no comparable division in Furrow *et al.* and no evidence in Retherford *et al.* (1981) that the child controls the semantic relations used in mother-child conversations. Perhaps it would be better to stop generating *post hoc* arguments for the linguistic utility of parentese and admit that this special register may be no more than one of the world's best described red herrings.

The fact that parentese exists, of course, is no argument for its didactic function. It may serve to express the relative social roles of parent and child (Blount, 1977; Shatz and Gelman, 1977), to achieve emotional bonding (Brown, 1977; Ferguson, 1977), to cope with an undisciplined and inattentive listener (Newport, 1976). So far, however, we have even less evidence for these effects than for a direct influence on child language. There is no reason why parentese must affect the child at all.

A less demanding view of this register comes from the literature on baby talk. Bynon (1977), among others, notes that parents *believe* that their special form of speech to children is necessary to the child's language learning. Kelkar (1964) observes that Marathi speakers *believe* that their baby talk closely resembles babies' talk. Instead, the linguist Kelkar proposes, it is analogous to 'mock missionary Marathi', the native's stereotyped imitation of European missionaries' pathetic attempts at Marathi. More generally, adult-child speech may be produced because it makes the producer happy.

This is not as unsettling a conclusion as it may seem. A behavior need not have any objective benefit to be performed, as the superstitious behaviors of pigeons in cages (Staddon and Simmelhag, 1971) or gamblers in casinos should tell us. Nor must a communicative behavior exactly match the perceptual capacities of the receiver of the message[17].

For instance, the male stickleback has an aggressive display which contains many more features than the reddened belly to which his rival actually responds. These features are neither here nor there so long as they do not obscure the red hemisphere. Analogously, if children learn language despite parentese, it is not a sufficiently counterproductive behavior on the part of an individual or a species to be driven to extinction by its unfortunate results.

IV.D.2. The Intelligibility of Parentese

If the utility of parental speech to its addressee is so far from proven, we have no *a priori* reason to suppose that parentese will solve the child's expected difficulties with speech perception. We have no evidence at all for facilitative effects of the physical and acoustic features of this register (Table 2.1) and no encouraging results for the relationship between progress and such potential simplifiers of higher order information as low m.l.u., sentoids per sentence, disfluencies, etc. Armed only with a list of suggestive adultese-parentese differences, we must approach the relative intelligibility of words in the two sorts of speech by direct experimental comparison.

Footnotes

1. The statistics, which are mine, are based on Lieberman's published raw data.

2. Rumor has it that Chomsky (1965) was referring to a sample collected by Maclay and Osgood (1959) during the discussion periods of a linguistics conference and exhaustively analyzed for disfluencies.

3. I will use 'maternal speech', 'MS', or 'motherese', however to refer only to speech produced by mothers for their own children. I will use 'paternal speech' for the speech of fathers to their children and parentese or 'parental speech' as a superordinate of the other two. 'Adult-child speech' will cover the speech of any adult to any small child. For the speech of older to younger children I am stuck with 'speech to younger children'. 'Adultese', of course, is what adults speak amongst themselves.

4. There may be other ethics for kings. Legend has it that James IV of Scotland isolated two children with a deaf and dumb nurse on an island in the Firth of Forth. He hoped they would come to speak Hebrew, then thought to be the Ur-Sprache. They did. Apparently there were also other ethics for scholars in the courts of kings.

5. Surprisingly, Remick's thesis includes only one inferential statistic: the F ratio (i.e. ANOVA) for articulation rates calculated on a treatment (adult vs child addressee) by subjects design. This fails to reach significance at the .05 level. Furthermore, no means for speech to adults overall or speech to children overall are supplied. Although Remick centres her discussion and may have wished to focus the reader's attention on developmental trends in the data, she offers no correlations between MS measures and age or m.l.u. of the child. Fortunately, she does provide a separate mean or total value for each measure for each mother speaking to her child or to an adult. All overall means, all t-tests and all correlations quoted in the present paper are therefore of my own computation.

6. I owe this point and the one that follows to John Laver.

7. The statistics on Broen's pause findings are my own.

8. Kary (1981) suggests that all the addressee effects are actually task effects. In a longitudinal study of the speech of nursery teachers to three pairs of children matched for age but differing in that one member was not a native speaker of English, she found no differences in speech to the natives and nonnatives or between these and speech to other adults, so long as the speaker and addressee were engaging in physical activity together. Within addressees, there were differences on a number of measures when activity ceased and the teacher began to narrate or explain something.

9. This point is made very emphatically by Newport *et al.* (1977, pp124–126).

10. This is not true for all those involved in higher order correlations in Newport *et al.* (1977, pp131ff).

11. Ringler reports an age effect for speech rate, but nearly all of the effects which she attributes to the child's age are, in fact, changes over time in speech to both child and interviewer i.e. those where there was a main effect for interview date. I will quote as significant only those cases where there is an interview date x listener interaction.

12. Of Cross' 83 measures of maternal speech, only 13 correlate with either a production or comprehension measure but not with both, and these are without exception measures showing only one significant correlation with language development. Even if language indices had no *a priori* tendency to intercorrelate, Cross would: both for parent and child she lists separately measures which constitute sub parts of other measures. Her results would be interesting only if they failed to show the mass of significant correlations which she finds.

13. It is worth noticing that the correlations I have calculated on Remick's data use linguistic stages (0-IV) (Brown, 1973) as their measure of language development, because exact m.l.u. figures were not available. Accordingly these correlations are much grosser indicators of MS-development relationships than any based on m.l.u.

14. Though Cazden is not specific on this point, it seems likely from her description of the day care center that the two experimenters represented the *S*s' only live contact with Standard American English. Since all of the developmental tests are based on Standard English, from which Black English differs in a number of ways, they may be testing something more akin to second dialect learning than first language acquisition.

15. Newport *et al.* compute progress as the score on their language test at time x' minus the score at x. Assuming that initial language level is equal for their subjects Furrow *et al.* use raw m.l.u., etc. at x'. These are suitable measures only if one assumes that the curve of language acquisition against time is *linear*. (I owe this observation to J.B.L. Bard). But as the authors insist that the curve is non-linear, they might have been wiser to use log scores.

16. In this section I discuss those MS characteristics for which at least one paper has found significant results, mentioning whether or not the other researchers confirmed those results. Where a paper is not included, it did not deal with the feature in question. Characteristics not mentioned either were not included in any of the relevant studies *or* did not show any significant correlations.

17. Sachs (1977), who claims that adult-child speech is a species-specific behavior, makes unwarranted claims with respect to perceptual matching.

CHAPTER THREE: Experiments with Adult Subjects

I. *Designing the Corpus and Establishing Initial Hypotheses*

The hypothesis that speech to young children should be more intelligible word-for-word than speech to adults could be tested only on a corpus including speech by the same individuals to child and adult addressees. The design of the corpus in fact allowed other hypotheses to be tested as well.

The corpus includes the speech of the fathers and mothers of the same children. The use of two speakers who know the child well and whom he can be seen to understand allows us, first of all, to distinguish between the effect of the child's linguistic development on the parent's speech and the propensity of a particular parent for varying his or her intelligibility. Second, it provides a broader test of the Intelligibility Hypothesis than the use of mothers' speech alone could do. As was mentioned in Chapter Two, many children are cared for by persons other than their mothers and any simple ideas we may have about young children's speech perception will be safe only if anyone a child speaks with adjusts his habitual intelligibility to suit the child's needs. Third, the use of both parents makes it possible to add to the growing body of work which suggests that paternal speech can be characterized as a variant of motherese (e.g. Rondal, 1979; Gleason, 1975; Rebelsky and Hanks, 1971). The accepted views in this area would predict that while fathers will also make their speech clearer for children, their adjustment might not be of the same magnitude as mothers'.

The corpus includes the speech of parents of children between 22 and 36 months of age, because this is the age range in which linguistic development is most rapid and in which most changes in motherese have been found (see

Snow, 1977a, for a summary). Thus, if parents actually adjust their delivery to the linguistic handicap of their child, we may find differences in the intelligibility of the speech to children across an age range over which the handicap reduces sizably.

Finally the corpus includes speech of boys' and girls' parents. Much work on motherese deals exclusively with the mothers of girls (see Snow and Ferguson, 1977) precisely because differences in maternal behavior with child sex have been identified which may be independent of the child's behavior (Lewis and Freedle, 1973). But as girls tend to show faster linguistic development than boys, it would be interesting to see whether a potential cause for their developmental advantage may be found in the clarity of speech addressed to them. If girls' parents speak more clearly to their children than boys', a girl might acquire her language faster because speech addressed to her is clear enough to allow her to recognize words from their acoustic shapes alone. And if a child can recognize the pieces of the linguistic puzzle, she should, or so our theories assume, be able to learn its rules by observing what the pieces do.

Thus the corpus used for this research was designed to make possible the testing of the following hypotheses:

1) that speech to children is word-for-word clearer than speech to adults;

2) that this increase in intelligibility is found in mothers' and fathers' speech;

3) that the intelligibility of speech to a child depends inversely on his linguistic development;

4) and that words spoken to girls are more intelligible than those spoken to boys.

I.A. Informants

The informants were the mother and the father of each of six children, one boy and one girl in each of three age groups (i. 22-24 months, ii. 28-30 months, iii. 34-36 months). All families had previously volunteered their children for studies on infant perception conducted in the Edinburgh University Psychology Department and were chosen because their children were the correct age and sex for the design and because they had been willing participants in the infant studies. All lived in the Edinburgh area. All were native speakers of English and though several were bilingual, none spoke any language other than English to their children.

The informants' ages, occupations, and places of residence before age 20 are listed in Appendix A.1. While it might have been desirable to sample socio-economic class or variety of British English more systematically, the mixture achieved is not untypical of the assortment of speakers that other Edinburgh residents, like the subjects described below, might normally encounter.

I.B. Corpus Collection

Both parents of each child were seen within a single fortnight, each on a separate occasion. The order of interview for mothers and fathers was roughly counterbalanced.

At each interview a child, a parent, and the Experimenter were present. The interview lasted approximately 45 minutes and was divided roughly into thirds. At the start of the session, the Experimenter asked the parent a series of questions about the family's linguistic background, the people who regularly spoke to the child, and the child's play habits. The questions were loosely based on a questionnaire included in Appendix A.2, but discussion was allowed to stray from the printed outline and become as anecdotal as possible. The purpose of this conversation was not so much to gain information as 1) to set the child at ease by directing attention away from him briefly, 2) to encourage the parent to believe that the object of study was the child's speech to adults during play, and 3) to elicit some speech from the parent about objects or events which might later form the basis conversation with the child. For the second third of the interview the parent played freely with the child using a standard set of toys, and in the final third each parent was asked to show and explain to the child the operation of a 'posting pagoda', which required color and shape matching as well as the careful manipulation of a set of color-coded keys. This toy proved complex enough to retain its interest even for the oldest children on its second presentation without being discouragingly difficult for the youngest.

Although the situation as designed might seem to require the parent to produce more casual and less urgently directive speech than he or she might ordinarily use to the child, the combination of the set task, which all parents pursued conscientiously, and the vicissitudes of toddlers' behavior gave rise to quite normal ranges of directive language.

All interviews took place in a sound-proofed recording studio containing a large table for the tape recorder, two adult's chairs, a child's chair and table and a cardboard box of toys. The tables were covered in felt, the floor carpeted, and the toys chosen to minimize noise which might mask speech. During recording the ventilator fan was turned off and a break in recording to clear the air generally occurred two-thirds of the way through the session. All recording was done on a Revox A77 Stereo tape recorder with a lavaliere microphone for the parent on one channel and a separate condenser microphone for the child on the other.

I.C. Transcription

The twelve tapes were all transcribed in the standard orthography by the Experimenter using either the same Revox A77 with its internal speakers or a Uher Report Stereo with headphones. Transcriptions were checked and corrected by two assistants, one of whom listened to all of the tapes while the other checked only those parts of the transcriptions from which experimental stimuli were chosen. At points of dispute the final version was always agreed by two of the three transcribers.

All experimental materials were first identified in the transcribed interviews and then located on the tapes.

II. The Initial Choice of Subjects

Even though the current research ultimately seeks a better understanding of young children's speech perception, it begins with a series of experiments using only adult Subjects. There were several reasons for this choice. First of all it was practical. The identification of words isolated from their original contexts is a task which adults can perform with appreciable and known differences in accuracy for various sorts of materials. Work on words to children using adult listeners was likely to produce results if there were results to be found. It remained to be seen how far the established techniques would have to be altered for use by child Subjects. Second, the choice of adult listeners made it possible to compare the present results to those of studies (Newport *et al.*, 1977; Garnica, 1977; Cross, 1975) which made use of adult Subjects, -- the Experimenters themselves -- , in estimating the relative intelligibility of motherese. And finally the choice was desirable from a theoretical point of view in two senses. There is a vast body of work on adult speech perception and relatively little on toddlers' against which the current results might be put into perspective. Also, whether children and adults perform alike on the tasks used here is actually an independent question and one central to this program of research. In the event, the results of the early experiments reported in this chapter made it necessary to approach the issue via a series of experiments on child Subjects which will be presented in Chapter Four.

III. Experiment 1: Random Words in Isolation

III.A. Purpose

The hypothesis that parents' speech to children is habitually clearer word-for-word than their speech to adults can be readily framed in two ways. On the one hand it might mean that a typical word spoken to a child has a greater probability of being correctly identified than a typical word to an adult. Typical words to a child, however, are typically not the same lexical items as typical words to an adult (Phillips, 1973), and consequently, this first reading of the hypothesis is distinct from one which proposes that parents pronounce any given lexical item more clearly than usual when they say it to a small child.

Given that some lexical items are likely to be more intelligible than others, for instance, because of their frequency of occurrence in the language or their length (Rosenzweig and Postman, 1958), for instance, either of the readings of the hypothesis could be true independently of the other. Parents might pronounce the same words more clearly to children but habitually use the less intelligible short words of the language to them, and so be less clear overall; or they might pronounce words less clearly to children but habitually use words which are more intelligible because they are the more common words of the language. In either of these cases the two versions of the

Intelligibility Hypothesis would produce different experimental results.

Accordingly it was necessary to examine each version of the hypothesis in turn. Experiment 1 is specifically designed to see whether a typical word in a parent's speech to his child is more intelligible than a typical word in his speech to an adult.

III.B. Method

III.B.1. Materials

The stimuli consisted of ten words taken from the speech of each parent to his or her child and another ten spoken by each to the *E*. The words were chosen randomly in the following way: a random number table was used in each case to select a page of the interview transcription and the next number in the random series determined which of the words on that page spoken to the listener under consideration should be used. If the word type chosen in this way had already been selected, or if the word token proved to be masked by other speech or extraneous noise, it was discarded and another one drawn by the same random procedure.

Next, each sentence[1] containing a stimulus word was copied from the interview tape on a Revox A77 to one channel of a tape loop on a second Revox. An electronic speech segmenter was then used to isolate the stimulus word. The segmenter makes it possible to copy from the loop either the contents of a time-labelled window alone or the rest of the loop without the window's contents. This experiment uses only the window's contents. The edges of the window were adjusted in milliseconds to the points where, by oscilloscope waveform and by ear, the best trade-off was found between excluding traces of adjoining words from the window and excluding traces of the stimulus word from the rest of the loop. While this method is not tantamount to the unsupportable claim that word boundaries can be located with absolute certainty, it does seem to serve its purpose. The words isolated in this way do not give the impression of containing intrusions from their surroundings. And the sentences, once the window is segmented out, do not noticeably retain phonetic material from the word other than some obviously anticipatory articulations.

The 240 words thus isolated are listed in Appendix B.1.

III.B.2. Design

The stimuli were divided into two Word Groups representing equally each Addressee (Adult,Child), each Parent Sex (Father,Mother), each Child Sex (Male, Female), and each Child Age (22-24, 28-30, 34-36 months). The 120 stimuli in each resulting Group were recorded from their loops to a presentation tape using a random order which included the 24 stimuli used for Experiment 2. Each stimulus was preceded by a number on the presentation tape and repeated three times in succession at intervals of roughly five seconds. For the loops and the final tapes an effort was made to hold constant the intensity level of the stimuli.

Half the Subjects heard each tape. The design was thus 3(Child Age) x 2(Parent Sex) x 2(Child Sex) x 2(Addressee) x 2(Word Groups) with repeated measures by Subjects on all variables except word group and with no repeated measures by materials.

III.B.3. Subjects

Forty native speakers of English who were undergraduates at Edinburgh University served as *S*s, twenty per Word Group. All were volunteers.

III.B.4. Procedure

*S*s were tested in groups of one to three in a soundproof recording studio. The presentation tapes were played monaurally on a Revox A77 recorder with two speakers. Each tape took about an hour to run and *S*s were allowed a brief rest in the middle of the session.

*S*s were told that each stimulus was a single 'real, true English word taken from conversational speech' and were asked to identify each stimulus in the appropriate space on a numbered answer sheet, guessing whenever they were uncertain.

III.C. Results

III.C.1. Scoring

The dependent variable was the number of letter-perfect or fully homophonous identifications of stimuli. (I.e. 'Rows','rose', and 'roes' would all be counted as correct identifications of a stimulus which actually represented 'rows', but 'row' or 'roe' would not.) Cell means for all the effects discussed below will be found in Table 3.1.

III.C.2. Statistical Method

Two features of the analysis deserve mention. The first has to do with the analyses of variance used. Throughout Chapters 3 and 4, account is taken of H. Clark's (1973) comments on the pitfalls of by-Subjects ANOVAs for experiments using small sets of stimuli which are intended to represent large populations of linguistic units. Clark points out that this sample-to-population ratio and the generalizations desired are criterial for defining a random effect. And he shows how failure to treat materials as random effects

TABLE 3.1

Experiment 1 (Random Words in Isolation). Mean Numbers of Words Correctly Identified per Five-Word Cell and Associated F-ratios.

Effect	Word Group	Speaker	Addressee: Child	Addressee: Adult	F_1	F_2	Min F′
1. Addressee	A	All	1.19	1.77	105.54 (1,19) p<.0001	6.64 (1,96) p<.05	6.25 (1,106) p<.05
	B	All	1.27	2.38	146.43 (1,19) p<.0001	15.72 (1,96) p<.05	14.20 (1,111) p<.001
2. Parent Sex	A	Mothers	1.66		25.54 (1,19) p<.0001	4.68 (1,96) p<.05	3.96 (1,115) p<.05
		Fathers	1.31				
	B	Mothers	2.08		31.81 (1,19) p<.0001	n.s.	
		Fathers	1.58				
3. Parent Sex x Addressee	A	Mothers	1.57	1.76	18.25 (1,19) p<.0004	n.s.	
		Fathers	0.86	1.80			
	B	Mothers	1.51	2.64	n.s.	4.93 (1,96) p<.05	
		Fathers	1.03	2.13			
4. Child Sex x Addressee	A	Parents of girls	1.67	2.02	14.83 (1,19) p=.0011	n.s.	
		Parents of boys	0.71	1.54			
	B	Parents of girls	1.56	2.11	36.39 (1,19) p<.0001	n.s.	
		Parents of boys	0.98	2.65			

TABLE 3.1 (cont'd)

Effect	Word Group	Speaker	Addressee: Child	Addressee: Adult	F_1	F_2	Min F'
5. Parent Sex x Child Sex x Addressee	A	Mothers of girls	2.33	1.55			
		Mothers of boys	0.81	1.97			
		Fathers of girls	1.03	2.48	83.94 $(1,19)$ $p<.0001$	6.79 $(1,96)$ $p<.05$	6.28 $(1,109)$ $p<.05$
		Fathers of boys	0.60	1.12			
	B	Mothers of girls	1.77	2.20			
		Mothers of boys	1.27	3.08			
		Fathers of girls	1.37	2.03			
		Fathers of boys	0.70	2.23	n.s.	n.s.	
6. Child Age x Addressee	A	Parents of children in G.i	1.71	1.75	70.74 $(2,38)$ $p<.0001$	6.19 $(2,96)$ $p<.005$	5.69 $(2,111)$ $p<.01$
		Parents of children in G.ii	0.81	0.55			
		Parents of children in G.iii	1.05	2.89			
	B	Parents of children in G.i	1.57	2.41	24.21 $(2,38)$ $p<.0001$	n.s.	
		Parents of children in G.ii	0.55	2.48			
		Parents of children in G.iii	1.70	2.26			

may lead to fallacious conclusions based only on an accidental characteristic of the particular sample employed. His preferred technique for analysis, and the one which has been adopted in the field, uses pairs of ANOVAs, one treating Subjects, the other stimuli as randomly sampled cases, as well as an easily calculated composite measure, min F' which has since been demonstrated to be much less prone to Type 1 error than either the by-Subjects (F_1) or the by-materials (F_2) estimate of an effect (Forster and Dickenson, 1976). Under this system, the F_2 for an effect will reflect the fact that the experimental stimuli are but a small sample of their population, and F_2 and min F' should constrain our generalizations from that sample.

Partly for these reasons it is now acceptable to treat effects involving materials as fixed effects in the calculation of ANOVAs by Subjects (see Coleman, 1980). Yet the design of the present experiment makes this approach difficult to defend in the case of Word Groups. As each of the two Groups is actually defined by a separate set of 20 Subjects, whose selection we must assume to be random, and a separate set of 120 randomly selected and assigned word tokens, Word Groups was likely to be a random effect in terms of size, sampling method, and import (see Winer, 1971, p.167; Cohen, 1976; Keppel, 1976). When word groups are so treated, however, numerous F-ratios in the ANOVAs have denominators with only one degree of freedom because they are provided by the Mean Squares for the appropriate interactions with Word Groups. Quite substantial effects are then prevented from reaching significance because of the extremely high critical values for F-ratios with (x,1) degrees of freedom. Since it was not always possible to pool estimations of error variance in order to recoup degrees of freedom for the denominators, the two Word Groups were examined in separate four-way ANOVAs, as if each one constituted an independent experiment with 20 Subjects and 120 stimuli.

This solution, which appears to be the most legitimate way of allowing the statistics to reveal major effects[2], has its disadvantages. First, lacking any interactions with Word Groups, the analysis can not now provide guidlines for determining when the two 'experiments' differ substantially. To compensate for this, a simple procedure was adopted. Whenever both Groups showed the same direction of a significant effect, any difference in its strength was ignored and the effect was considered as established. Whenever an effect showed different directions in the two Groups, it was treated with some suspicion. This strategy seemed to accord with the nature of the hypotheses being tested, as all predict only direction and not degree of difference. The second difficulty lies in the fact that the two Word Groups do not actually comprise independent replications. Though they contain different stimuli and use different Subjects, they both sample words from the same twelve speakers. The required response here is to refrain from making the sorts of claims for generalizability that truly independent replications would allow.

A second characteristic of the analysis that may need some clarification is the use of Scheffé tests for all comparisons internal to ANOVA effects, whether the comparisons were planned or post hoc. The reason for this choice was the usual one: as the most conservative method of comparison, scheffe tests should minimize the probability of Type 1 errors over the many comparisons which had to be made.

III.C.3. The Findings

III.C.3.a. Addressee

As Figure 3.1 illustrates, far from supporting the hypothesis that a typical word in parents' speech to a child is more intelligible than a typical word to an adult, the results show that words to children are very reliably harder to recognize. This result held both in group A (F_1=105.54, df=1,19, p<.0001; F_2=6.64, df=1,96, p<.05; Min F'=6.25, df=1,106, p<.05) and in Group B (F_1=146.43, df=1,19, p<.0001; F_2=15.72, df=1,96, p<.001, Min F'=14.20, df=1,111, p<.001).

The effect is not restricted to either sex of parent but it reaches significance more often for fathers (Scheffés at p<.05 within the Parent Sex x Addressee interactions by Subjects in both groups and by materials in Group B) than for mothers (Scheffé at p<.01 by Subjects in Group B only).

III.C.3.b. Parent Sex

Mothers' speech proved more intelligible overall than fathers', but the main effect for Parent Sex was more convincing in Group A (F_1=25.54, df=1,19, p<.0001; F_2=4.68, df=1,96, p<.05; Min F'=3.96, df=1,115, p=.05) than in Group B (F_1=31.81, df=1,19, p<.0001; F_2<1).

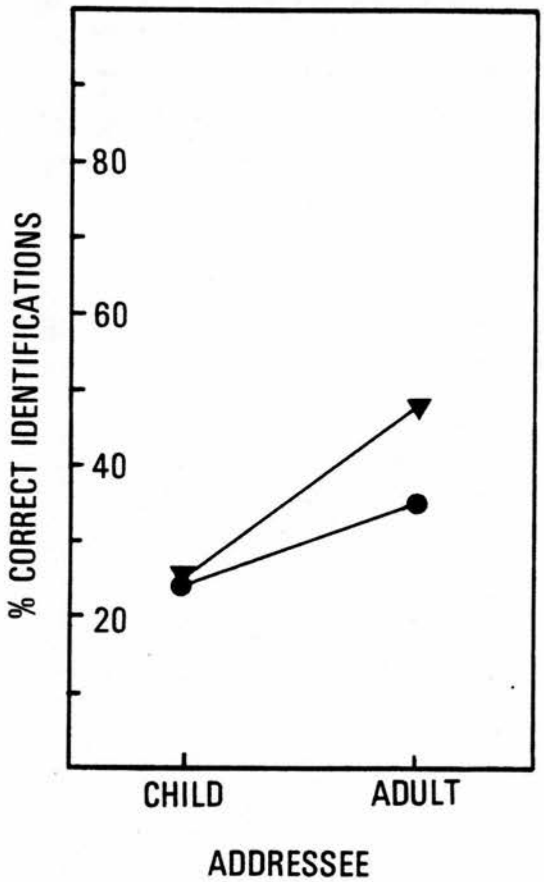
The effect is more marked in mothers' speech addressed to children where the 'Mother Advantage' reaches significance in both groups (Scheffés at p<.05 within Parent Sex x Addressee by Subjects) and rather less so in speech to adults where it appears only in Group B (Scheffé at p<.05 by Subjects).

III.C.3.c. Child Sex

Both word groups showed a Child Sex x Addressee interaction by Subjects only (A: F_1=14.83, df=1,19, p=.0011; F_2=1.16, df=1,16, n.s.; B: F_1=36.39,

FIGURE 3.1

Experiment 1 (Random Words in Isolation): The Addressee Effect Expressed as Percentage of Judgements Correct.



Key:
● Group A
▼ Group B

df=1,19, $p<.0001$; $F_2<1$). This effect can safely be interpreted as a 'Girl Advantage' rather than as a 'Girls' Parent Advantage' because speech to girls is more intelligible than speech to boys throughout (Scheffé tests at $p<.01$ in both groups by Subjects) while speech to the adult by girls' parents is clearer in Group A and less clear in Group B than the speech of boys' parents (both Scheffé tests at $p<.01$ by Subjects).

Although the Girl Advantage appears in both mothers' and fathers' speech, it is clearly related to the fact that only mothers of girls do not show the Addressee effect which appears for each of the other parent groups in one part of the data or the other (Scheffé tests at $p<.05$ within Child Sex x Parent Sex x Addressee). In the two Word Groups used here (See Figure 3.2), mothers either speak almost as clearly to their daughters as to the Experimenter (B: Scheffé test at $p>.05$) or they speak more clearly to their children (A: Scheffé test at $p<.05$).

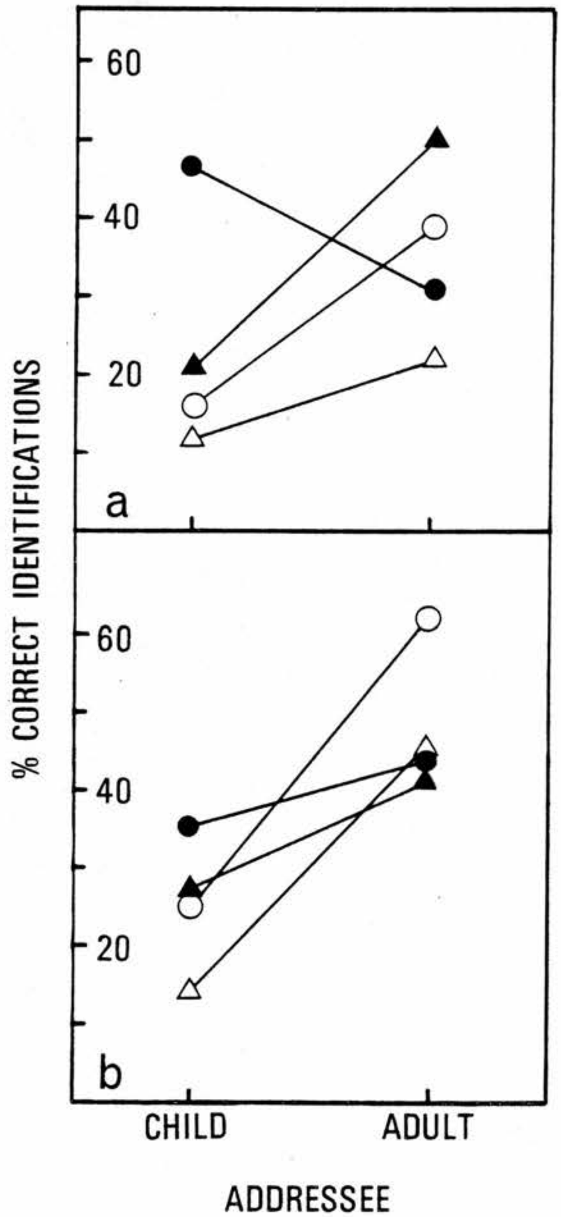
III.C.3.d. Child Age

Though both Groups produce an interaction between Child Age and Addressee (Group A: $F_1=70.74$, df=2,38, $p<.0001$; $F_2=6.19$, df=2,96, $p<.005$; Min $F'=5.69$, df=2,111, $p<.01$; Group B: $F_1=24.21$, df=2,38, $p<.0001$; $F_2=2.90$, df=2,96, n.s.), the pattern of results reveals no consistent developmental trend.

The effects for both Addressees are inconsistent across word groups. As Figure 3.3 shows, though there are no Child Age effects for speech to the adult in Group B, the Group A half of the sample shows quite obvious changes in the intelligibility of speech to the adult with the age of the child (All differences are significant at $p<.05$ by Subjects and the difference between

FIGURE 3.2

Experiment 1 (Random Words in Isolation). The Effect of Child's Sex and Parent's Sex on the Addressee Effect Expressed as Percentage of Judgements Correct. (Figures 3.2.a and 3.2.b show results for Groups A and B respectively)



Key:
- ○ Fathers of girls
- ● Mothers of girls
- △ Fathers of boys
- ▲ Mothers of boys

Child Age iii and each of the others reaches $p<.01$ by materials). More serious, the Group A and Group B samples of speech to children show different age effects: in A the words to Age i children are clearer than those to other groups and in B the Age i and the Age iii words are both clearer than the Age ii (Scheffé tests at $p<.05$ by Subjects).

A further examination of Table 3.1 and Figure 3.3 will show, nonetheless, that the disorderly pattern of results does not overwhelm the Addressee effect. The trend towards the 'Child Disadvantage' is present in five of the six comparisons and reaches significance by at least one Scheffé test in each group: in A at $p<.01$ for Age iii by Subjects and in B at $p<.01$ for Age i by Subjects, at $p<.01$ for Age ii by Subjects and by materials, and at $p<.05$ for Age iii by Subjects.

III.D. Discussion

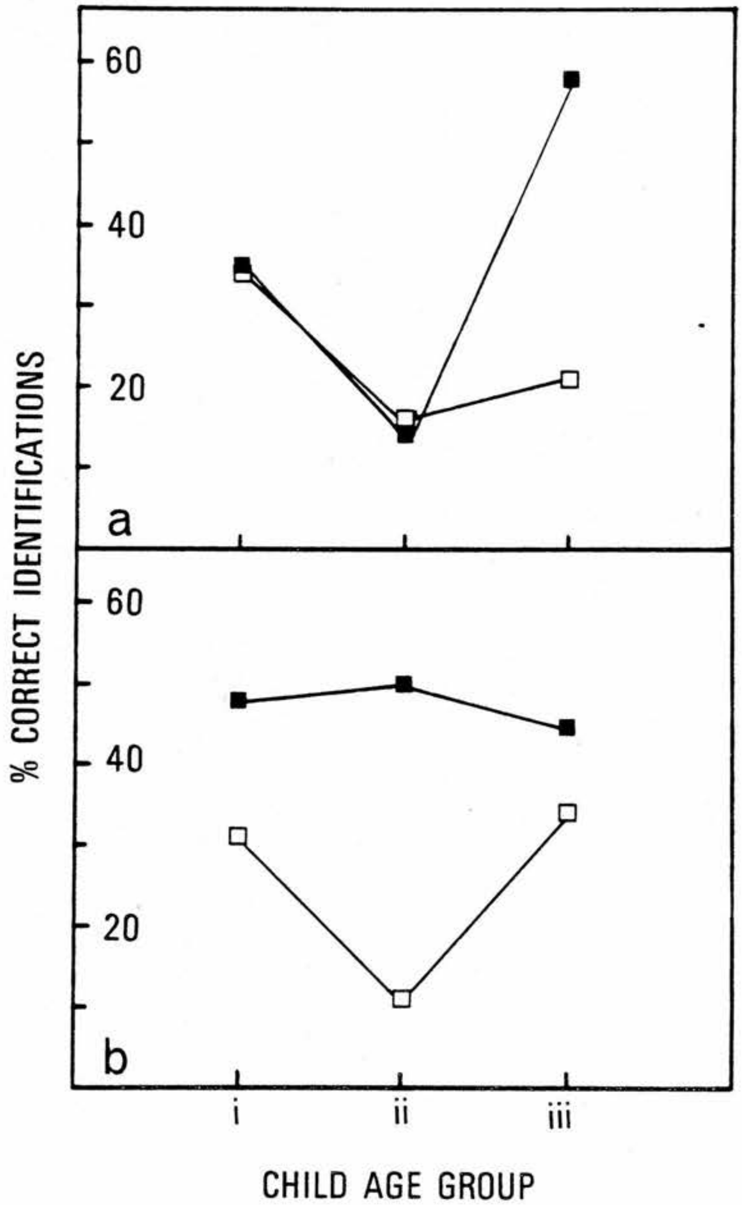
Experiment 1 yields a number of notable results. First of all the Addressee effect is the opposite of the one predicted. Second, there is no consistent effect of Child Age on the intelligibility of words sampled from speech to children. Third, mothers' words, particularly mothers' words to children, are more readily identified than fathers'. And fourth, words spoken to girls are more intelligible than words to boys whether the speakers are mothers or fathers, though mothers in particular speak more clearly to girls. All these bear further discussion.

III.D.1. The Addressee Effect

The finding that speech to children is distinctly less intelligible than speech to adults is certainly the most counterintuitive result of Experiment

FIGURE 3.3

Experiment 1 (Random Words in Isolation). The Effects of Child Age Expressed as Percentage of Judgements Correct. (Figures 3.3.a and 3.3.b represent Groups A and B respectively.)



Key:
■ Words spoken to adult
□ Words spoken to child

1. It directly contradicts the prediction of the Intelligibility Hypothesis (see Section I.A.) that speech to listeners with less capacity for top-down speech perception should be physically clearer and therefore better suited to bottom-up recognition, and it seems to contradict the received wisdom on the nature of motherese.

A careful look at the methods used by earlier studies, however, may help to put the present results into perspective. First, let us consider the studies which found motherese to be clearer than adultese. Remick (1971,1976), Broen (1972), and Newport *et al.* (1977) all counted instances where a whole sentence could not be satisfactorily transcribed because it contained confusing errors of syntax and semantics or an unrecognizable string of syllables. Because these researchers were interested in syntax, they dealt with the integrity of sentences and with the recognition of words within their sentence contexts. The present study, however, deals with word tokens isolated from just such contexts, and Pollack and Pickett's (1963) findings warn us that there may be differences between the results of the two techniques[3]. Furthermore, two of the three relevant studies (Remick, 1971, 1976, and Newport *et al.*, 1977) used only the speech of mothers of girls, while in the present experiment only mothers of girls failed to show the Child Disadvantage. The other work which suggests that motherese is outstandingly clear is Garnica's (1977). Although Garnica did examine individual word tokens, her materials come from readings of written texts and her measures of clarity are actually predictions from such measures as pitch change within a syllable and the number of words carrying primary stress as measured by syllable length. But nothing in Garnica's method precludes the present results. It is quite conceivable that when an adult reads to a child a description or a set of instructions not of his own devising, the output has a sort of 'Playschool' enunciation which has little to do with speech of the 'Let go of that right now' variety. And it is also possible that features which ought to produce greater intelligibility either do not do so or occur in spontaneous speech so rarely as to fail to influence a random sample of word tokens. Thus the present results may be out of line with the received view because the present sampling and measurement methods are new to the field.

Now let us turn to the one study which fails to support these others. Shockey and Bond (1980) found reliably more operations of four common phonological reduction rules per opportunities in mothers' speech to children than in speech to adults. The expectation here is that it will be harder for children to recognize word tokens in mothers' speech to them because their first or last segments will be distorted in a way which can only be corrected by a listener who has mastered the phonology of word boundaries. When such tokens are artificially isolated, of course, they will be difficult to recognize even for adults, because they lack the contexts which condition the reductions. Shockey and Bond's results, then, sit very well with Experiment 1.

Although the present work may thus merely be filling gaps in the motherese literature rather than directly contradicting it, the Child Disadvantage is still unsettling. Far from helping their children by producing highly intelligible word tokens, parents appear to produce words which are very significantly less intelligible than those they use for an adult listener and, as Figure 3.1 shows, that is very unintelligible indeed.

III.D.2. The Child Age Effect

No amelioration of what we may suppose are the child's dire straights appears in the form of a Child Age effect. In fact, it is difficult to interpret the present findings as revealing any true effect of Child Age.

To appreciate the perplexing nature of the results, let us consider the pattern to be expected if speech to small children were less intelligible than speech to adults and if its intelligibility increased as the child matured. In this situation, speech to an adult by all parents should be more or less uniformly intelligible: there should be no change with Child Age. Speech to the children, on the other hand, should increase in intelligibility with Child Age. But Figure 3.3 shows that neither Group yields this pattern. Although the Group B sample of speech to the adult shows no Child Age effects, the Group A sample quite obviously has some. More important, speech to children not only fails to show any resemblance to a monotonic ascending curve, it even fails to produce consistent results across the two Word Groups. In A the words to Age i children are the clearest and they ought by the simplest theory to be the least clear. In B, on the other hand, the Age i and Age iii the words to children reveal the expected pattern.

Of course, a true Age effect might be non-monotonic and non-ascending, but it should still not be accompanied by marked changes over Child Age in speech to an adult. In fact, it is difficult to attribute effects as inconsistent as these to anything but a sampling accident.

The particular accident involved is not in the sampling of speakers. Since the two word groups both sampled equally from the same twelve speakers, the accidental differences between samples must work within speakers. Nor is the accident the result of some interdependence in the intelligibility values for a single speaker's speech to the two listeners. A brief account of a subsidiary analysis will show that this is so.

Analysis of Variance is appropriate only if the scores in various cells are independent of one another. The analysis of raw scores which was outlined in

Section III.C might, therefore, be compromised if a particular speaker was always outstandingly intelligible whether he was speaking to his child or to another adult because in this case sets of scores to adult and to child would not be independent. The less overwhelming effects, like Child Age x Addressee, might then be mere artefacts of an unsuitable analysis[4]. Since the Child Age x Child Sex x Parent Sex interaction was significant at least by Subjects (A: $F_1=24.87$, df=2,38, $p<.0001$; $F_2=1.41$, df=2.96, n.s.; B: $F_1=10.21$, df=2,38, $p<.0003$; $F_2=1.05$, df=2,96, n.s.), we have some reason to believe that the informants, who correspond one-to-one to the cells of this interaction, were not uniformly intelligible speakers and some reason to suspect that the intelligibility of the particular speakers who happened to have children of particular ages might produce a pseudo-Child Age effect. Although examination of Figure 3.3 does not encourage this conclusion, as the curves for adult and child listeners do not run parallel, it still seemed worthwhile to ensure that some sort of interdependence was not responsible for the findings[5].

Consequently the data for Experiment 1 were converted into difference scores. For each Subject the score for words to the children in a particular Child Age x Child Sex x Parent Sex cell was subtracted from the score for words to the adult. A similar process was used for the by-materials analysis except that here, since there were no repeated measures, words to children and to adult by the same speaker were randomly paired to permit the calculation of difference scores. The resulting analyses will be found in Appendix B.2.

Their outcome does not differ markedly from the raw score analysis. The effect of Child Age on the Addressee effect is strong, but as Figure 3.4 shows, still differs from one Word Group to the other (A: $F_1=65.06$, df=2,38, $p<.0001$; $F_2=5.82$, df=2,48, $p=.0055$; Min $F'=5.34$, df=2.56, $p<.01$; B: $F_1=22.85$, df=2,38, p<.001; F_2=3.39, df=2,48, p=.042; Min F'=2.95, n.s.)[6].

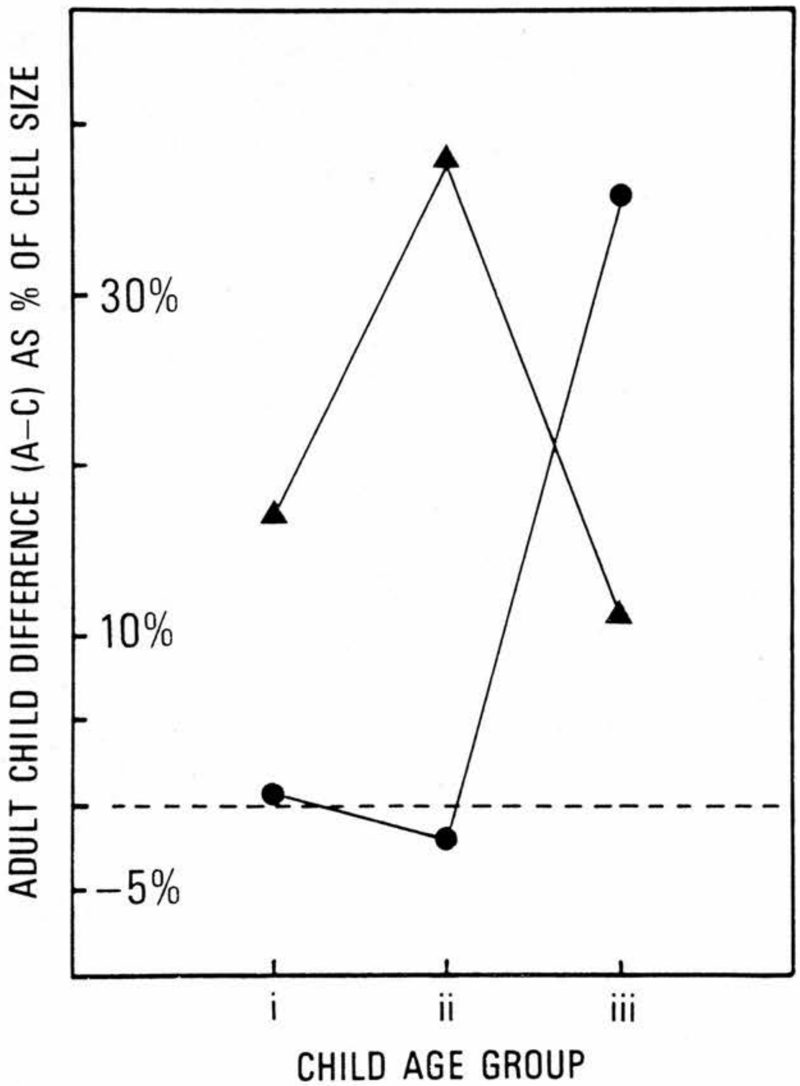
The most sensible conclusion available may be that these differences are caused by a sampling accident at the level of individual words. Substantial word-to-word differences seem to be at work in this data, for by-materials analyses, both in this experiment and in later ones, regularly fail to achieve the significance levels of the analyses by Subjects. Now, because Child Age has three levels and each of the other variables only two, each n-way interaction with Child Age will have fewer cases per cell than any n-way interaction not involving Child Age. For example, in the analysis by Subjects, where each Word Group contains 480 measurements (20 Subjects x 2 Child Sexes x 2 Parent Sexes x 2 Addresses x 3 Child Ages) a Child Sex x Addressee comparison is based on 120 measurements per cell, while Child Age x Addressee is based on 80. Therefore at any level of interaction the one most likely to be swamped or made artefactual by variance among the words in a cell should be the interactions with Child Age -- just because they have the smallest chance of overcoming word to word differences via the law of large numbers. It is not unreasonable to conclude, then, that Experiment 1 reveals only a word sampling artefact here and shows no true effect of child age on intelligibility[7].

III.D.3. Child Sex

While the Girl Advantage is precisely what Section III.A predicts, the effect becomes quite difficult to explain in the light of the Child Age results. One might want to argue that parents speak more clearly to girls than to boys of the same age because the girls are likely to be more linguistically advanced and therefore more similar to adults who receive very much clearer speech. But with no evidence for an improvement in intelligibility

FIGURE 3.4

Experiment 1 (Random Words in Isolation): The Child Age Effect, in Different Scores



Key:
● Group A
▲ Group B

with Child Age, that argument falls flat. If a child who is nearly three is spoken to no more intelligibly than a child who is not yet two, a few extra percentage points of m.l.u. should not secure for a girl speech that is dependably more intelligible than that addressed to a boy of the same age. Furthermore, a developmental explanation will not in itself account for the absence of the Child Disadvantage in mothers' speech to girls and its presence in fathers'.

Given present results, it seems more reasonable to suppose that the origins of the Child Sex effect have nothing to do with the child's linguistic behavior, though the results of the effect may. Lewis and Freedle (1973) reported that differences in mothers' verbal behavior toward male and female infants began at a time (four weeks) when no differences in the infants' responses were noted, but that such differences were noted by the time the infants were twelve weeks old. It is tempting to reason that like the mysterious behavior of Lewis and Freedle's sample, the Girl Advantage is the result of as yet unspecified factors in the relationship between parents and their small daughters which may have among its results the later observed differences in the linguistic behavior of boys and girls.

III.D.4. Parent Sex

The Parent Sex effect is equally difficult to explain. Fathers were included in the study partly to test the notion that parentese characteristics ought to be exhibited by all speakers familiar with a child, though they might appear in a less extreme form in fathers than in mothers. The results support these suppositions only in small part.

Both mothers and fathers do show a parentese effect, now redefined as reduced intelligibility in speech to children, but mothers show it less strongly than fathers. In part, this difference occurs because mothers of girls fail to show the effect and because mothers of boys show it to a lesser degree than their husbands, but in part it is also due to the generally greater intelligibility of mothers' speech -- whoever the listener may be.

This finding is not easily accounted for on simple acoustic grounds alone. Women's speech ought in general to have a higher fundamental frequency than men's and, with a high F_0, more widely spaced harmonics. But more widely spaced harmonics should on average intersect the formants of speech sounds less often and so provide less information about the segments contained in the speech. Thus, we might expect mothers' speech to be less intelligible than fathers'[8], particularly since mothers are known to adopt a higher than usual F_0 when addressing children in our age range (Garnica, 1977; Remick, 1971). The greater observed intelligibility of mothers' speech indicates that some other explanation is needed here.

A number are available. First, we may not have a sample showing higher F_0 in mothers' speech. The fact that mothers increase their F_0 range as well as their mean F_0 when speaking to two-year-olds (Garnica, 1977) makes this possible. Secondly, F_0 may not correlate significantly with intelligibility here, as Margulies (1979) suggests: she found that when signal intensity was held constant, women's speech was more intelligible than men's. Or, thirdly, other aspects of word choice and delivery may correlate with intelligibility much more strongly than F_0 and outbalance its effects. While the scope of the present work will not allow direct investigation of F_0 measures, the findings of Chapter 5 will reflect on the issue of individual word intelligibility.

IV. Experiment 2: Matched Words in Isolation

IV.A. Purpose

Whatever is made of the Mother Advantage and the Girl Advantage, the principal result of Experiment 1 must be the Child Disadvantage. The random sample of words used in Experiment 1, which was designed to assess typical intelligibility allows two possible sources for this effect. Parents may typically use word types to different listeners which differ in intelligibility because of their shape, frequency of occurrence, etc. (Rosenzweig and Postman, 1958), or they may simply adopt a particularly unclear pronunciation when they speak to children, or indeed both processes may operate together. Experiment 2 is designed to determine whether pronunciation *per se* contributes to the Addressee effect.

This experiment compares the intelligibility of pairs of tokens of the same word as said by the same speaker, one produced in the course of conversation with an adult and the other in conversation with a child. If the Addressee effect appears for these matched stimuli, then it cannot be solely the result of word choice.

IV.B. Method

IV.B.1. Materials

The materials were composed of two pairs of words spoken by each of the twelve parents. Each pair consisted of two spontaneous tokens of the same word type, one for each addressee. A different word type was chosen for each pair so that 24 lexical items are represented by the 48 tokens. The context sentences were copied and the stimulus words extracted by the method described for Experiment 1. The word tokens are listed in their context sentences in Appendix B.3.

IV.B.2. Design

The stimuli were divided into two Word Groups so that neither contained both members of any pair or both words by any parent to a single addressee. Each Group represented each Child Age, Child Sex, Parent Sex, and Addressee equally and half the *S*s heard each Group. The experimental design is thus similar to that used in Experiment 1.

IV.B.3. Subjects and Procedure

The stimuli were randomized and presented with those for Experiment 1 to the same two groups of 20 *S*s.

IV.C. Results

IV.C.1. Scoring

Responses scored as for Experiment 1 yield the means displayed in Table 3.2.

IV.C.2. Statistical Method

The results were submitted to 2(Addressee) x 2(Child Sex) x 2(Parent Sex) x 2(Word Group) Analyses of Variance with repeated measures for all variables by Subject and for Addressee alone by materials. Child Age, though it features in the experimental design, is omitted from the analysis for two reasons. First, summing across Child Age was the simplest way to avoid a binary dependent variable. And second, the results of Experiment 1 revealed no interpretable Age effect, so that it hardly seemed worthwhile to look for one here[9].

TABLE 3.2

Experiment 2 (Matched Words in Isolation): Mean Numbers of Words Correctly Identified per Three-Word Cell and Associated F-ratios.

Effect	Speakers	Addressee: Child	Addressee: Adult	F_1	F_2	Min F´
1. Addressee	All	1.15	1.38	9.93 (1,38) p=.0033	n.s.	
2. Parent Sex	Fathers Mothers	0.830 1.70		155.69 (1,38) p<.0001	7.68 (1,16) p<.025	7.32 (1,18) p<.01
3. Parent Sex x Addressee	Fathers Mothers	0.83 1.48	0.83 1.93	12.82 (1,38) p<.001	n.s.	
4. Child Sex x Addressee	Parents of boys Parents of girls	1.13 1.18	1.56 1.19	12.18 (1,38) p=.0012	n.s.	
5. Child Sex x Parent Sex x Addressee	Fathers of boys Fathers of girls Mothers of boys Mothers of girls	1.00 0.65 1.25 1.70	0.85 0.80 2.28 1.58	21.98 (1,38) p=.0001	n.s.	

In these ANOVAs, Word Groups was treated as a fixed effect because the Groups do not represent random samples and because the assignment of tokens to Word Groups was not random.

Since the pairs of word tokens were matched only across the two levels of Addressee, the results of this experiment are most relevant to the Addressee effect and its interactions. For other effects this experiment is only a small replication of Experiment 1.

IV. C. 3. Findings

The overall Addresee effect remains a Child Disadvantage (see Figure 3.5), though it is significant only by Subjects (F_1=9.93, df=1,38, p=.003; F_2<1). The interaction between Parent Sex and Addressee (F_1=12.82, df=1,38, p<.001; F_2<1) reveals that the Addressee effect reaches significance only in mothers' speech (Scheffé test at p<.01 by Subjects) and the Child Sex x Addressee interaction (F_1=12.18, df=1,38, p=.0012; F_2>1) shows an effect only for boys' parents (Scheffé test at p<.01 by Subjects).

In fact, as Figure 3.6 illustrates, only boys' mothers display the effect to a significant degree (Parent Sex x Child Sex x Addressee: F_1=21.98, df=1,38, p<.0014; F_2=2.24, df=1,16, n.s.; Scheffé at p<.01 by Subjects). The trends for the other parent groups do not approach significance at the .05 level.

Finally, the main effect of Parent Sex, -- the Mother Advantage -- , is the only one to reach significance by materials as well as by Subjects (F_1=155.69, df=1,38, p<.0001; F_2=7.68, df=1,16, p<.025; Min F'=7.32, df=1,18, p<.01).

IV. D. Discussion

The results of Experiment 2 encourage the belief that parents' pronunci-

FIGURE 3.5

Experiment 2 (Matched Words in Isolation). The Addressee Effect Expressed as Percentage of Judgements Correct

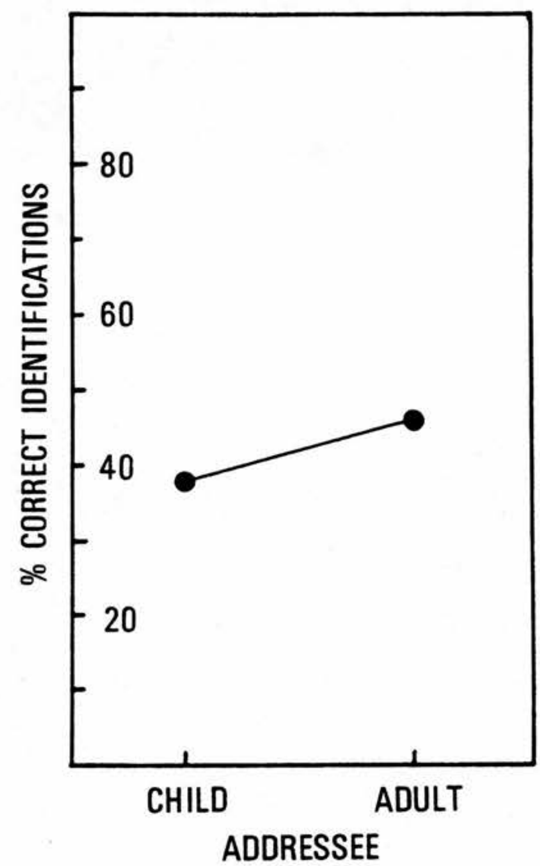
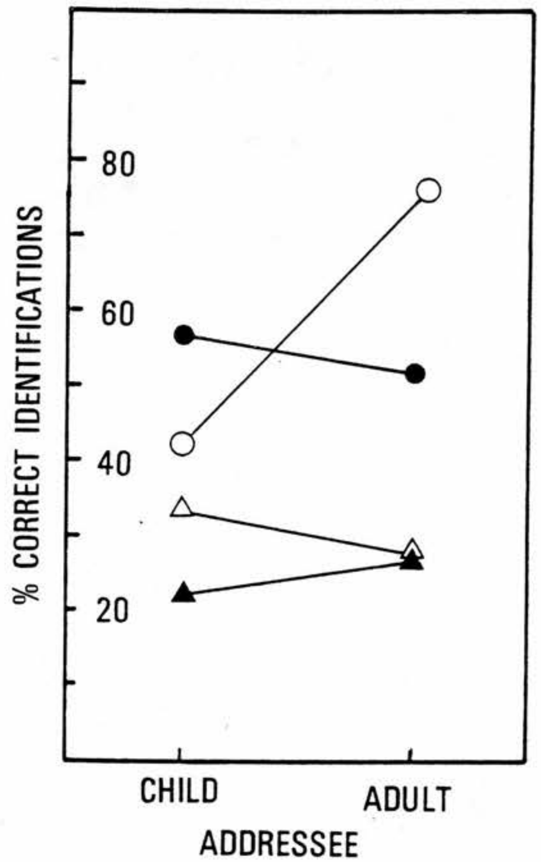


FIGURE 3.6

Experiment 2 (Matched Words in Isolation). The Effect of Child's Sex and Parent's Sex on the Addressee Effect Expressed as Percentage of Judgements Correct.



Key:
▲ Fathers of girls
● Mothers of girls
△ Fathers of boys
○ Mothers of boys

ation makes a contribution to the Addressee effect but is not solely responsible for it. The similarities between Experiment 1 and 2 findings show that the Child Disadvantage works both for typical speech and for matched words. The same Addressee effect is found in both and it is in both cases more prominent in speech to boys than in speech to girls. In fact, girls' mothers still fail to show the effect (see Figure 3.6). Since word shape is matched across Addressee in Experiment 2 we must conclude that the parents sampled in these experiments tended overall to less clear delivery in speech to their children than in speech to the Experimenter.

But the differences between the two experiments redirect our attention from how parents speak to what they say. The Addressee effect is much smaller for Matched Words (compare Figure 3.1 with Figure 3.5). If the variance which we eliminated by using Matched Pairs, the variance among word types between Addressees, had been masking the Addressee effect, then the Addressee effect should have been greater in Experiment 2 than in Experiment 1, but of course it is not. Also, Experiment 1 showed significant Addressee effects by materials, while Experiment 2 shows none. This fact must be partly due to the sizeable variance among words noted earlier and the small word sample (24 types) used here. But in Experiment 2 the effect of intertype variance is great enough to overwhelm the Addressee effect by materials and therefore to show us that the finding is not to be trusted for all word pairs. So far as the present corpus is concerned, then, pronunciation is not the major factor in the Addressee effect.

In fact, Experiments 1 and 2 support the conclusion that the choice of different words for different listeners, far from damping the Addressee effect actually magnifies it. Thus we would predict that the vocabulary of parents' speech to children will be the word types expected *a priori* to be less intelligible. The effects, if any, of parents' pronunciation should only exaggerate this more basic process.

V. Experiment 3: Words in Context

V.A. Purpose

However consistent they are, the results of Experiments 1 and 2 are so unexpected that it is necessary to show that they are not merely artefacts of the accidental choice of abnormal materials. The original materials might be atypical of parents' speech in yielding less than the usual 80-85% agreement among transcribers, or the words chosen might simply be unrecognizable in context to listeners other than the three original transcribers who may have persuaded each other to perceive what one of them only imagined. The corpus used here might also be abnormal in failing to reveal the greater integrity of speech to children when it is examined sentence-by-sentence in the usual way. Experiment 3 is designed as a control which should detect anomalies of these sorts.

Experiment 3 presents Experiment 1 and 2 stimuli within their immediate linguistic contexts. To count as normal, the words should prove transcribable in context and if they show an Addressee effect, it ought to be in the direction of greater intelligibility for speech to children.

V.B. Method

V.B.1. Materials

The materials consisted of the tape loops from which all 48 of the Experiment 2 stimuli (Matched Words) and 96 of the Experiment 1 stimuli (Random Words), four from each parent to each Addressee (see Appendix B.2), had been segmented. Here, however, the whole sentence, including the original stimulus word, remained audible.

V.B.2. Design

The stimuli were divided into two Groups of 72 items so that each contained the sources of half the Matched and half the Random Words. The two members of a matched pair were always assigned to different Groups and each Group represented each level of Addressee, Child Age, Child Sex, and Parent Sex equally. The stimuli in each Group were copied to a presentation tape in random order, announced by number, and repeated three times. Since the repeat was arranged here as in the earlier experiments simply by running the loop three times, the interval between repeats of a stimulus word was the same as it had been before. Half the subjects were assigned to each Group.

V.B.3. Subjects and Procedure

The *S*s were twenty native speakers of English who were students at the University of Edinburgh, ten per Group. They were run in small Groups under exactly the same listening conditions as the *S*s in Experiments 1 and 2. Now, however, they were asked to transcribe the whole 'phrase or sentence' verbatim onto a numbered answer sheet.

V.C. Results

V.C.1. Scoring

Transcriptions were examined only for the words used in Experiments 1 and 2 and were scored correct under the same criteria. Results are summarized in Tables 3.3 and 3.4.

TABLE 3.3

Experiment 3 (Words in Context). Mean Numbers of Random Words Correctly Identified per Six-Word Cell and Associated F-ratios.

Effect	Word Group	Speakers	Addressee Child	Addressee Adult	F	F	Min F′
1.Addressee	A	All	5.65	5.53	n.s.	n.s.	
	B	All	5.28	5.60	5.83		
					(1,9)		
					p=.035	n.s.	
2.Parent Sex	A	Fathers	5.48		6.69		
		Mothers	5.70		(1,9)		
					p=.03	n.s.	
	B	Fathers	5.25				
		Mothers	5.63		n.s.	n.s.	
3.Parent Sex x Addressee	A	Fathers	5.55	5.40			
		Mothers	5.75	5.65	n.s.	n.s.	
	B	Fathers	4.95	5.55	4.05		
		Mothers	5.60	5.65	(1,9)		
					.10>p>.05	n.s.	
4.Child Sex x Addressee	A	Parents of boys	5.85	5.45	7.31		
		Parents of girls	5.45	5.60	(1,9)		
					p=.024	n.s.	
	B	Parents of boys	5.05	5.45			
		Parents of girls	5.50	5.75	n.s.	n.s.	
5.Child Sex x Parent Sex x Addressee	A	Fathers of boys	5.90	4.90	26.30	4.70	3.98
		Fathers of girls	5.20	5.90	(1,9)	(1,40)	(1,49)
		Mothers of boys	5.80	6.00	p=.0006	p=.05	.10>p>.05
		Mothers of girls	5.70	5.30			
	B	Fathers of boys	4.40	5.20			
		Fathers of girls	5.50	5.90			
		Mothers of boys	5.70	5.70			
		Mothers of girls	5.50	5.60	n.s.	n.s.	

TABLE 3.4

Experiment 3 (Words in Context). Mean Numbers of Matched Words Correctly Identified per Three-Word Cell and Associated F-ratios.

Effect	Speakers	Addressee: Child	Addressee: Adult	F_1	F_2	Min F′
1. Addressee	All	2.80	2.30	50.00 (1,18) $p<.0001$	7.93 (1,16) $p<.025$	6.85 (1,21) $p<.025$
2. Parent Sex	Fathers	2.23		64.72 (1,18) $p<.0001$	8.72 (1,16) $p<.01$	7.69 (1,20) $p<.025$
	Mothers	2.88				
3. Parent Sex x Addressee	Fathers	2.60	1.85	11.25 (1,18) $p=.0035$	n.s.	
	Mothers	3.00	2.75			
4. Child Sex x Addressee	Parents of boys	2.83	2.10	12.79 (1,18) $p=.0022$	n.s.	
	Parents of girls	2.78	2.50			
5. Child Sex x Parent Sex x Addressee	Fathers of boys	2.65	1.70			
	Fathers of girls	2.55	2.00			
	Mothers of boys	3.00	2.50			
	Mothers of girls	3.00	3.00	n.s.	n.s.	

V.C.2. Statistical Analysis

Results expressed as percentages were compared in a by-materials t-test to those in earlier experiments. The raw scores for Matched and Random Words were then submitted to separate ANOVAs. Each of the two Groups of Random Words was submitted to separate 2(Child Sex) x 2(Parent Sex) x2(Addressee) Analyses of Variance with repeated measures on all variables by Subjects and none by materials. The reasons for taking the groups separately are those outlined in Section III.C.2. The Matched Word ANOVAs, on the other hand, included Word Group as a variable and so were analogous to those used in Experiment 2.

V.C.3. Findings

The most obvious finding is illustrated in Figure 3.7: the stimuli were readily identifiable in context. Overall, 89% of identifications were correct, significantly more than in isolation ($t=7.4$, $df=143$, $p<.001$).

As Figure 3.7 also shows, there was now no Addressee effect in Group A Random Words ($F_1=1.10$, $df=1,9$, n.s.; $F_2<1$). In Group B, the Addressee effect recurred only by Subjects ($F_1=5.83$, $df=1,9$, $p=.035$; $F_2=1.80$, $df=1.40$, n.s.) and in a much weaker form than in Experiment 1 (compare Figures 3.1 and 3.7).

In contrast, the Matched Words ANOVAs revealed a substantial Addressee effect overall ($F_1=50.00$, $df=1,18$, $p<.0001$; $F_2=7.93$, $df=1,16$, $p<.025$; Min $F'=6.85$, $df=1,21$, $p<.025$). But whereas the token of a lexical item which was addressed to an adult had been easier to recognize in isolation, it was now harder to recognize in its immediate linguistic context. This result was significant for both fathers' and mothers' speech and for the speech of boys' and girls' parents (all Scheffé tests at $p<.05$ by Subjects).

Although the Addressee effect was reversed for Matched Words, the Parent Sex effect remained the same as before: mothers' words were more readily identified than fathers' overall ($F_1=64.72$, $df=1,18$, $p<.0001$; $F_2=8.72$, $df=1,16$, $p<.01$; Min $F'=7.69$, $df=1,20$, $p<.025$) and in speech to each addressee taken separately (Scheffé tests at $p<.01$).

V.D. Discussion

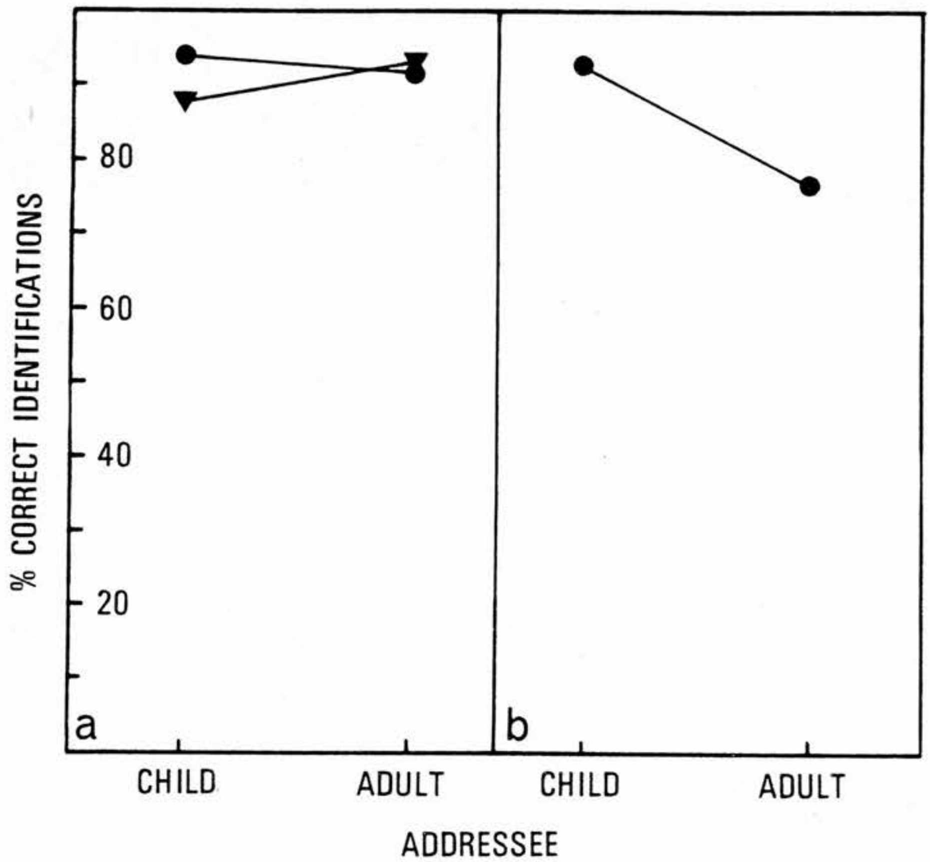
The results of Experiment 3 indicate that the materials used in the earlier experiments were neither artefacts of transcription nor necessarily in conflict with published findings.

Although this outcome means that Experiments 1 and 2 must be taken seriously, it makes the work more perplexing. There is, after all a change in the direction of the Addressee effect for the very same materials. Only half of the Random Words show any tendency to retain the Child Disadvantage in context. The other half show the opposite trend, and in the Matched Words exactly the same recorded tokens of words to children which were the more difficult to identify in isolation proved the easier to identify in their immediate linguistic contexts. Though the gist of the motherese literature is in line with the findings for words in context, it cannot account for the results for words in isolation and it contains nothing which will predict any reversal between the two. For a suitable explanation, Experiment 4 will look outside maternal speech research and back to a suggestion made by Lieberman (1963).

The kind of explanation we seek will be limited by the second oddity in Experiment 3: although the Addressee effect reverses for some words in con-

FIGURE 3.7

Experiment 3 (Words in Context). The Addressee Effect Expressed as Percentage of Judgements Correct. (Figures 3.7.a and b represent Random and Matched Words respectively)



Key:
● Group A
▼ Group B

Key:
● Groups A and B

text, the Parent Sex effect does not. Mothers' words are still better recognized than fathers'. This must mean that intelligibility effects have multiple causes, some of which interact with linguistic context while others do not.

Whatever account is found for the results of Experiment 3, one implication is clear: the words spoken to children in other experiments on parental speech might have been as unintelligible as those spoken in the present corpus but those studies never observed the Child Disadvantage because they always examined words within contexts which can neutralize or reverse it.

VI. Experiment 4: Redundancy in Context

VI.A. Background and Purpose

Lieberman (1963) demonstrated that, in sentences read aloud, the more redundant or predictable a word token is in its immediate linguistic context, the less intelligible it is likely to be when artificially isolated from that context. Several studies have suggested that mothers' speech to children is more redundant than their speech to adults (Phillips, 1973; Cross, 1975, 1977) but these used type-token ratio for words and utterances as a measure of redundancy. If adult-child speech is also more redundant than adult-adult speech in the sense that words in it are more predictable from their contexts, then Subjects hearing whole adult-child sentences might be better able to identify individual words because they can make use of their highly informative contexts. Since they were so redundant in context, the words addressed to children might have been the less carefully articulated and therefore the less intelligible when isolated. Experiment 4 tests the related hypotheses: that there is a difference in predictability with Addressee and that this difference can explain the Addressee effect for the intelligibility of artificially isolated words.

VI.B. Method

VI.B.1. Materials

The 48 tape loops for the Matched Words and an equal number for Random Words (half of those used in Experiment 3) provided the materials for Experiment 4, but now the contents of the windows, the stimulus words used Experiments 1 and 2, were omitted from them. The loops in question are marked in Appendix B.3.

VI.B.2. Design

The stimuli were divided into two Groups exactly as they had been in Experiment 3 and arranged in random order. On the presentation tapes each stimulus was announced by number and repeated three times in succession. A typed numbered transcript of the stimuli was also prepared with a blank of constant length substituted for the missing word. The printed text was used to approximate the conditions in Lieberman's experiment and to eliminate any effects on predictability of the degree of intelligibility of linguistic contexts themselves. Half the *S*s heard each Group.

VI.B.3. Subjects

Two Groups of 34 Edinburgh University undergraduates served as *S*s. All were urged to participate by the directors of the first and second level linguistics courses in which they were enrolled and testing took place during an introductory class meeting.

VI.B.4. Procedure

The presentation tapes were played on the same equipment used in earlier experiments and *S*s were asked to listen to each stimulus and to write the word which they believed had been deleted in the appropriate blank on the transcript/answer sheet.

VI.C. Results

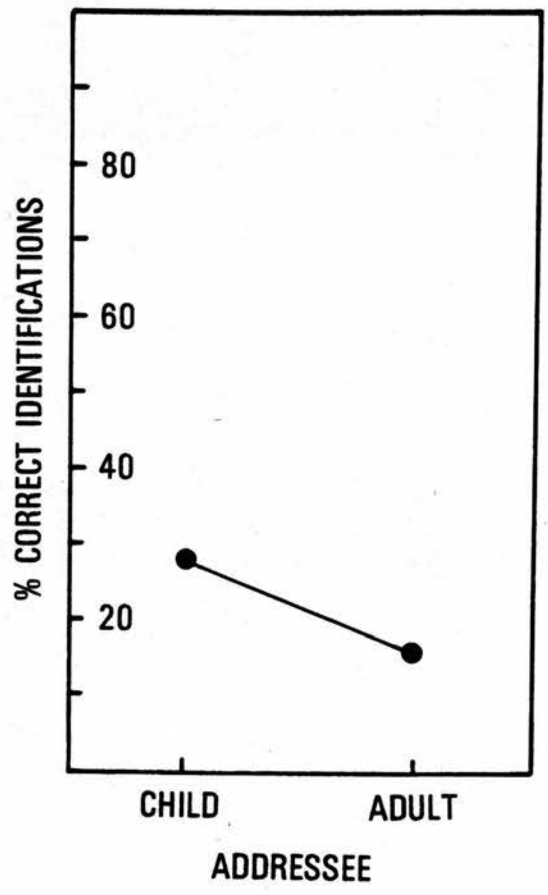
Responses were scored correct only if they reproduced the omitted item perfectly.

The prediction derived from Cross' and Phillips' results was fulfilled. As Figure 3.8 shows, although filling in the missing words was a difficult task, words to children were better predicted from their immediate linguistic context than words to adults: 28% of the guesses at words to children were correct as against 16.25% of the guesses at words to the adult. An uncorrelated t-test by words shows that the difference is highly significant ($t=3.09$, $df=94$, $p<.005$, one-tailed). The effect holds for Random Words taken as a Group (37.1% correct to child vs. 14.3% to adult: $t=1.90$, $df=46$, $p<.05$, one-tailed) but fails for Matched Words (19.1% vs. 18.6%).

The prediction from Lieberman's results was also fulfilled: redundancy in the form of observed predictability from context correlates negatively with intelligibility in isolation. Over all words there was a highly significant negative correlation between redundancy as measured in Experiment 4 and intelligibility as measured in Experiments 1 and 2 ($r=-.303$, $t=3.08$, $df=94$, $p<.005$, one-tailed). While the relationship only approaches significance for words to adults ($r=-.214$, $t=1.49$, $df=46$, $.10>p>.05$), and while it is actually quite significant for words spoken to children ($r=-.339$, $t=2.44$, $df=46$, $p<.01$),

FIGURE 3.8

Experiment 4 (Predictability from Sentence Context). The Addressee Effect as Percentage of Deleted Words Correctly Supplied.



the two correlations do not differ substantially ($\bar{z}$=-.645, p=.27). Like the Addressee effect in redundancy and in intelligibility, the redundancy x intelligibility correlation is stronger for Random Words(r=-.548, t=4.45, df=46, p<.001) than for Matched Words (r=-.086, t=.585, n.s.). Here the difference between the r-values is sizable ($\bar{z}$=-2.51, p<.01).

On the other hand, the observed relationship between predictability from and intelligibility in context was negligible. Correlations ranged from -.059 for words spoken to children to .128 for words to adults and none differed significantly from zero.

VI.D. Discussion

Experiment 4 was intended to help explain the presence of the Child Disadvantage found for words in isolation and its disappearance for words in context. The results can be taken as explaining only the first of these.

The Child Disadvantage clearly has something to do with the redundancy of speech to children. Experiment 4 shows that words spoken to small children are more redundant in context than words spoken to an adult. It also shows that Lieberman's (1963) result is true for spontaneous speech and particularly true for speech to children: when a word is more predictable, it is also less intelligible. Thus the Child Disadvantage could occur because parents produce more redundant messages for their children than for their peers and because they tailor delivery not to the linguistic capacities of the listener but to the local predictability of the words being produced.

Some details of the findings give particular comfort to this notion while another indicates that it needs refining. The corroborating details involve the strength of the correlation in various subsets of the materials. First, even though the idea that parentese should adjust to all the child's linguistic limitations predicts quite the opposite, the relationship between word intelligibility and predictability is at least as robust for words to children as for words to adults. Our claim that redundancy may determine intelligibility is not weakened by any diminution in the correlation for young addressees. Then, too, the correlation is highly significant where the Addressee effects are strongest -- for Random Words. Under these circumstances, attributing Addressee effects to redundancy differences is almost irresistible.

But redundancy is supposed to affect word intelligibility by allowing speakers to pronounce words less carefully. If the redundancy of words in the present materials accounts for their intelligibility, we ought to expect a strong Addressee effect where only pronunciation differences are at stake -- in Matched Words. But we do not find this at all: Matched Words show the weaker Addressee effect for intelligibility in isolation, no Addressee effect for redundancy, and an insignificant correlation between the two measures. Indeed, Experiments 1 and 2 were taken as attributing the bulk of the Addressee effect to word choice rather than word delivery. The story must be more complicated than the version which is so hard to resist.

Perhaps the added wrinkle can be created by proposing an association between lexical items and redundancy levels. It is not too difficult to imagine how such an association might work. Suppose, for example, that parents use more anaphoric pronouns to children than to adults[10]. Personal pronouns are very nearly semantically empty and when they are used anaphorically, like 'they' in this sentence, must be almost totally predictable from context. They are also very short words and on grounds both of word length and of predictability ought to be quite unintelligible. It is probably only when these pronouns are used contrastively (as in 'Jack and Jill went up the hill but *he* was the clumsy one.') that they are not redundant and that they carry what is generally called contrastive stress to make them intelligible. Thus if parents were given to using pronouns, or similarly predictable words to children, both word choice and context-related word delivery would contribute to the Addressee effect. And, of course, the other half of the effect might be exaggerated if parents chose to use longer words, which, Zipf (1965) tells us, have more semantic content, in conversation with adults. The more meaningful items are presumably used because they are needed, that is, because there is information to be communicated which is complex and which is not carried by the rest of the message. These items should be more intelligible both because by nature they are less predictable and so attract better delivery and because they are longer and so ought in general to be relatively easier to recognize. Whether the present materials perform according to this scenario is a question which Chapter 5 will hope to answer. For now we need only accept the possibility that predictability of word tokens may lie behind the results for artificially isolated words.

Predictability seems to have a good deal less to do with intelligibility in context. If the latter were largely a function of the former we would, of course, expect a strong positive correlation between the two. But the observed correlation, though generally positive, is close to zero. And if predictability were responsible for reversing the Addressee effect in Matched Words between Experiments 2 and 3, then Matched Words ought to show particularly healthy correlations between redundancy and intelligibility. But they show a significantly weaker correlation than Random Words which produced no such reversal. These results are not entirely surprising, for although it is known that our ability to recognize speech on-line depends partly on the contextual constraints on it (eg. Marslen-Wilson and Welsh, 1978), some role must be left for bottom-up processing of the sounds which the speaker actually produces. At any rate, the results of Experiment 4 leave us in comfortable possession of a plausible explanation for the novel findings of this study, the Child Disadvantage for isolated words. It may be left to the originators of the findings for words in context to explain them in the light of the new evidence.

VII. General Discussion

The work reported in this chapter was originally directed towards protecting language acquisition theories against the complications attendant on considering the difficulty of speech perception for the linguistically naive. It has not fulfilled this aim because parental speech is not easier to decipher word-for-word than ordinary conversational speech, but very dependably harder. This result is found at a very high significance level in two samples of typical words to each addressee (Experiment 1) and to a lesser degree in a sample which matches words to both (Experiment 2). Insofar as a child needs to process speech bottom-up, then, parentese should be a hindrance rather than a help.

However counterintuitive these results may seem, they are not a sampling artefact, but rather a previously unnoticed characteristic of otherwise typical materials. Like the speech which Pollack and Pickett readily transcribed and later presented word by word, the stimuli used here proved to be considerably easier to identify in their linguistic contexts than in isolation (Experiment 3). Indeed listeners' success at identifying words in context, -- about 89% correct overall, -- is typical of the agreement usually found among transcribers of parents' speech. Furthermore, when heard in their immediate linguistic contexts, as is customary in motherese studies, the present materials showed either no Addressee effect (Random Words) or the finding reported in the literature (Matched Words), that speech to children is the more decipherable (Experiment 3). The differences between the motherese results and those in Experiments 1 and 2 may be due to the inclusion in the present sample of parents other than girls' mothers, who behave atypically, and of the present use of word tokens without the support usually available to adults in the words' immediate linguistic contexts.

The Addressee effect revealed by this paradigm appears to be mediated in several different ways. As speakers say a given word type less intelligibly to their small children than to an adult, the way in which the two tokens are pronounced must be involved. And pronunciation may include both the care with which segment strings are articulated and their suprasegmental characteristics, such as the difference between male and female voices or voice quality changes in a single speaker. A comparison of Experiments 1 and 2, however, has shown that pronunciation is not the only source of the Addressee effect. Because the effect is more marked when different words are used for each addressee, the speakers' choice of lexical items seems to contribute as well.

In fact, the stronger Addressee effect in randomly selected words makes the results more, rather than less convincing. Parents do regularly seem to use different lexical items to child and adult. Phillips (1973) found, for example, that the ratio of Latinate to Anglo-Saxon verbs was different for the two. The ratio of concrete to abstract nouns and of action to non-action verbs also has been found to differ (Phillips, 1973; Ringler, 1973). And though it was by no means impossible to find matched word pairs for the present experiments, it was considerably easier to choose unmatched words randomly without replacement. A fair estimate is that less than 10% of words chosen randomly had to be discarded specifically because they had already been used to the other addressee. The situation in which the Addressee effect was the stronger, then, seems to be the better representation of the population of words to children.

What can have induced a parent to speak less clearly to a less able listener is the subject of Experiment 4. Here it was shown that, in general, words in speech to children are more predictable from their immediate linguistic contexts than words in speech to adults, and it was also shown that parents allow the intelligibility of their delivery to vary inversely with the predictability of the word they are uttering. While this practical slackness makes good sense when the listener has mastered the linguistic regularities which underlie the predictability of words, it makes very little sense when he does not have a full command of the language. Yet when parents speak to their young children, delivery depends on predictablility slightly more than when they speak to adults. This finding directly contradicts the general characterization of motherese as a register which is well 'tailored' to the linguistic sophistication of the child (Snow, 1977a).

Equally mysterious are two other factors shown by Experiments 1 and 2 to control the intelligibility of speech to children: the child's and the parent's sex. While the girls' parents speak more clearly to their children than the boys' do, the data show no developmental effect which might support the notion that the Girl Advantage in intelligibility marks parents' response to a similar advantage in linguistic development. Furthermore, mothers of girls show less of an Addressee effect than any other parent group, including the fathers of the same girls. This fact suggests that it is not the child's linguistic development which controls parental intelligibility. instead, the crucial factor would seem to be some dimension to the relationship between mothers and daughters which cannot be defined in terms of the variables considered here. Similarly, the parameters manipulated in these experiments offer no straightforward account of the finding that the Child

Disadvantage is stronger in fathers' speech than in mothers and are of little use in explaining what makes fathers less intelligible than mothers throughout the series of experiments. The bases of these effects must be sought through other techniques.

However its details are accounted for, the work reported in this chapter has one very important implication: that the nature of parental speech provides no obvious solution to the problems of the young listener's word recognition. Instead, words to children are both relatively and in an absolute sense, unintelligible. The relative unintelligibility of parentese is impressive not only because it is highly significant, but because we know that, since a smaller vocabulary is used for children than for adults (Remick, 1971; Phillips, 1973; Ringler, 1973), our sample mean for children is the more representative of the intelligibility of its population. And that mean, even if it is not considered in contrast with adult-adult speech, is abysmally low. As Figure 3.1 shows, adults who have mastered the vocabulary involved can recognize the tokens from speech to children only 30% of the time. Whichever way we choose to view them, words spoken to children are largely unintelligible.

In the light of this fact, two major questions present themselves: why are these words so unclear and, more important, are they unclear for child listeners, too?

The first question has to do with characteristics of the present stimuli. How do the choices of particular word types and particular pronunciations of them combine to give less clear speech to children? What physical and stochastic parameters are related to intelligibility in the present sample? Answers to this set of questions will be sought in Chapter 5.

The second question is more central. Given that the Intelligibility

Hypothesis would seem to be disconfirmed, how does the young child cope with stretches of sound which adults can seldom recognize? Does he hear them as adults do and use non-linguistic cues to classify them as tokens of English words? Or is the child who is still learning his language a much better bottom-up processor of speech than the adult he will become? To explore the variants of what we have called the Perception Hypothesis, we must examine the behavior of child Subjects and this is the task of Chapter 4.

Footnotes

1. 'Sentence' will be used to mean either a fully grammatical sentence or, if the stimulus word was not produced in a full sentence, a string of words separable from preceding and following strings on semantic or intonational grounds.

2. The third or easy way out is, of course, to treat Word Groups as a fixed effect. An ANOVA with the appropriate design was run by Subjects, and none of what will be discussed in the next pages conflicts with its results.

3. What happens when the present materials are heard in context is, in fact, the topic of Experiment 3.

4. I owe this suggestion to P. Fisk.

5. It has been pointed out to me by T. Pitcairn that interdependence might take on forms other than parallel lines for speech to child and adult. For example, a limitation in overall range of intelligibility might impose a ceiling on the Adult Advantage of clear speakers and a floor on the Child Disadvantage of the unclear, while the median speaker showed the maximum Addressee effect. As it happens, however, this pattern is not revealed by Figure 3.3 or by the loci of significant cell differences (see III.C.3.d above).

6. Nor does the difference score analysis offer to change any of the conclusions here. As a perusal of Appendix B.2 will reveal, the Addressee effect is still robust (both Min F' values are at $p<.025$ or better) and there is evidence for the Child Sex and Parent Sex effects discussed in the following sections.

7. The extension of this argument ought to be that no interaction with cell size less than 80 should be taken seriously in this experiment. The treatment adopted violates this principle in two ways. First, Child Sex x Parent Sex x Addressee is taken as a 'real' effect. This sin is relatively venial,

because here the two Word Groups provide consistent results so that one might want to say that n=120 rather than 60. And as the result fails to recur in later experiments, it is not among the major results of the research. Second, if the higher way interactions are thus judged not to be true effects, they ought to be plowed back into the error term of the ANOVA. Yet a glance at Table 3.1 and Appendix B.2 will show that these interactions are often resoundingly significant, so that it was difficult on purely statistical grounds to justify pooling them with error. After expert statistical examination failed to reveal flaws in the methodology which would account for the very significant higher order interactions, it seemed safest to adopt the middle way: the interactions remain in the ANOVA though they are arguably only the result of inter-word variance.

8. I owe this point to J. Laver.

9. In fact analyses of variance with Child Age were actually performed but yielded no more information thanthose presented here.

10. Ringler (1973) claims they do while Remick (1971) finds a trend in the opposite direction.

CHAPTER FOUR: Experiments with Child Subjects

I. Introduction

The finding that words spoken to children are less intelligible than words to adults ought to present some difficulty to any view of first language acquisition which assumes that words in the input stream can be recognized as a matter of course. If we make the simple assumption that children perform only as poorly as adults when recognizing word forms without the support of linguistic context, we will predict that in such situations they should successfully identify only about three of every ten familiar words spoken to them. Whenever the child's proximal linguistic stimulus is this limited, all aspects of language acquisition present fairly daunting tasks. Insofar as the child's early ignorance of syntax prevents him from using structural information in speech perception, he would have to learn new syntax by observing the behavior of 30% of the occurrences of those few lexical items which he has already mastered. Although any structural generalizations which he managed to derive in this way might subsequently reduce his dependence on the acoustic information in a word token, the most straightforward implication here is that the early stages of this process must be very slow and faltering. And how the child might simultaneously determine phonological representations for new lexical items from what generally seems to be a very 'degraded' signal is particularly mysterious. In fact, for any area of language acquisition which requires the child to observe the use of the language, an extremely limited proximal stimulus could be a considerable handicap. Or at least it is a handicap within those currently available frameworks which assume that usable examples of whatever the child is to learn are readily available. Because children do acquire language without convincing us that they suffer hardships of this sort, we might wish to reorganize our theoretical approaches to this issue.

Before embarking on any such project, we ought to return to what Chapter One called the Perception Hypothesis. The assumption that children perform as poorly as adults on parentese may simply not be true. Most work on motherese has tacitly assumed that children and adults perceive in identical ways and that, therefore, judgments made by adult listeners or by adult linguists will describe difficulty rankings for children, but this supposition could easily be false.

It is, for instance, possible that young children are skilled at what Marslen-Wilson and Tyler (1980) call 'sound-driven word recognition' to the extent that they can identify a word given only its acoustic shape, even when adults cannot. These special acoustic processing skills might be allowed to atrophy in favor of a more 'interactive' approach to speech perception as the child gradually acquires linguistic knowledge with which his acoustic analyses can interact. If this is so, the problem isolated by Pollack and Pickett's work will not be a problem for young child listeners at all.

Alternatively, Sachs (1977) may be correct when she argues that there is a match between infants' perceptual capacities and the peculiarities of adult-child speech, and that this match is part of the innate behavioral repertoire of our species. If toddlers retain some form of this propensity, they might be no better than our adult *S*s at recognizing words from adults' conversations but appreciably better at dealing with words addressed to other young children. An inbuilt lock and key match between our production and their perception could then protect them against the Pollack and Pickett effect.

Perhaps children's perceptual peculiarities involve the interaction of linguistic and extra-linguistic factors. As it is a truism that adults speak to small children about objects and events which are present to the senses at the time, a child might simply scan the environment to determine what the speaker might be talking about. He could then use his observations to predict which known words the speech sounds could sensibly represent, or which as yet unlabelled referents they might supply words for. If this suggestion holds, young listeners should be quite competent at recognizing words whose denotanda are present and relatively incompetent otherwise. The fact that the denotanda are usually present when he is spoken to will then mitigate the unintelligibility of words addressed to the child.

The experiments in this chapter attempt to deal with these proposals by testing the intelligibility of segmented word tokens for child listeners. Experiments 5 and 6 develop a technique for eliciting word recognition judgments from three-year-olds. Experiment 7 compares the performance of child and adult Subjects on words originally addressed to toddlers or adults and explores the effects on both sets of listeners of the presence of items named by the stimuli. Finally, Experiments 8 and 9 attempt to explain why certain words addressed to children are particularly clear.

II. Pilot Studies

II.A. Choosing a Method

II.A.1. The Task

The task used for child Subjects was based on that used for adults in Experiments 1 and 2. Subjects still had to identify tape-recorded word tokens isolated from the original corpus (see Chapter 3, Sections I.B-D and III.B.1), but instead of ranging over all word classes, the stimuli now consisted only of object names. Rather than merely repeating the words they thought they heard, the young Subjects were to choose from a set of toys the item which was named by each stimulus.

The motivations for these changes are quite simple. Object names were chosen because they were plentiful in the corpus of speech to both addressees; because they constitute a class of words which children begin to acquire early (see Brown, 1973, and Nelson, 1973) and some of which, therefore, they might be expected to recognize in speech; because it is relatively easy to pretest a Subject for his mastery of these stimuli; and because they would permit a nonlinguistic response measure. This last seemed preferable to naming because it would not lose data differentially from children who were particularly shy about speaking to strangers or whose speech the Experimenters found difficult to understand. In the event (see Section III.C.1 below), when children did name their choices aloud, there was almost total agreement between objects named and objects chosen.

II.A.2. The Child Subjects

All the experiments in this chapter used three-year-olds as Subjects almost exclusively. The children addressed in the original corpus materials were somewhat younger (22-36 months), but the two-year-olds who were run in pilot studies and in later experiments were much less cooperative than the older children and were too young to attend most of the local nurseries to which access was obtainable. Together, the low access rate and the high wastage rate for two-year-olds would have made it nearly impossible to fill any but the simplest experimental designs. On the other hand, three-year-olds have certainly not mastered all of the language[1] and so should still depend to some extent on any of the special strategies sketched above which functions in the younger children.

II.B. Experiment 5: Words of Known Intelligibility to Adults

II.B.1. Purpose

This short experiment was intended to pilot the object-selection method described above and to determine whether it could produce intelligibility differences analogous to those found for adult listeners.

II.B.2. Method

II.B.2.a. Materials, Design, and Subjects

The materials consisted of eight of the single-word stimuli used in Experiments 1 and 2, four addressed to adults and four to children. Two of each group had been found to be of High Intelligibility to adult Subjects in earlier expriments (16-20 out of 20 listeners correct) while the other two were of Low Intelligibility (0-3 correct). The words and their scores in the adult experiments are listed in Table 4.1.

The materials were divided into two groups with one word from each of the four cells of the design in each and a separate tape was prepared for each. Each tape contained two citation forms read onto the tape by a female speaker of Scottish English, as practice stimuli, and then the four segmented forms, each repeated three times in succession at roughly five-second intervals. All *S*s heard both tapes in the same order on two successive days.

Fifteen children (six girls and nine boys) of average age 43.5 months served as *S*s. All attended the Edinburgh University Psychology Department Nursery and had served as Subjects in other experiments.

II.B.2.b. Procedure and Apparatus

On the day before the first test session, children were taken individually to the nursery's testing room and familiarized with a set of toys including those representing the test items (a doll-house door, wheels from a toy car, a small doll, a toy boat, a small jigsaw puzzle, a Lego tree, stairs built of small Lego, and a pair of doll's shoes), as well as eight other toys on the same scale. The *S* was asked by *E* to name each toy as she removed it from an opaque bag. If *S* could not produce the name of any object, *E* named it. Then the child was asked to find each object in the collection as *E* named it and to replace it in the bag. All *S*s were able to find all named objects.

During the test sessions, *E* sat on the floor behind a low table on which stood an upright Revox A77 Stereo Recorder and its two external speakers. Some six to eight feet away, on the child's side of the tape recorder, stood another low table on which the full set of 16 toys was arranged. *S* was asked to fetch from the table the toys demanded by a monkey hand puppet who, the child was told, was not allowed out to get them because he had a bad cold. As the cold might make the monkey's voice odd and difficult to understand, *S* was to listen carefully and guess if he was uncertain as to what the monkey was asking for. All *S*s agreed to help the puppet and all retrieved objects, whether correct or not, were greeted enthusiastically by the monkey and returned to the child to be replaced on the table. *E* took care to keep her face out of sight until the child had retrieved an object so as to provide no clues to the correct choice. Videotapes taken during the running of this pilot study by a second *E* who remained behind the video camera, revealed that children looked directly from the puppet to the table or only at the table during and after the presentation of each stimulus.

TABLE 4.1

Experiment 5 (Child Subjects. Words of Known Intelligibility to Adults). Numbers of Subjects Correctly Identifying Each Word.

a. Test Words

Intelligibility to Adults (Expt 1, 2)	Original			Addressee		
	Adult			Child		
	Word	Adult Score	Child Score	Word	Adult Score	Child Score
High	DOOR	17	1	JIGSAW	20	13
	WHEELS	16	9	TREE	20	10
Low	DOLL	0	0	STAIRS	1	2
	BOAT	3	13	SHOES	2	4

b. Citation Forms

Group 1	SAUCER		12	BASKET		15
Group 2	LION		15	CUP		13

II.B.3. Results and Discussion

Table 4.1 lists the numbers of Subjects making the correct choice for each of the test words and practice items.

A two-way (Intelligibility x Addressee) Analysis of Variance by Subjects showed a trend towards better responding for words addressed to children (mean number correct out of two: to Adult, 0.7; to Child, 0.93; $F_1=3.33$, df=1,4, p=.089), a significant effect for Intelligibility (High: 1.03, Low: 0.60; $F_1=11.49$, df=1,14, p=.0044), and a very significant interaction in favor of highly intelligible words originally addressed to children (High to Child: 1.53, Low to Child: 0.33, High to Adult: 0.53, Low to Adult: 0.87; $F_1=86.12$, df=1,14, p<.0001). None of these effects was significant by materials.

Whatever lack of generality the small set of stimuli produces, this experiment does show that the technique is a useful one. First of all, the mean score for both ANOVAs was significantly greater than zero, indicating that overall, there was an appreciable degree of correct responding ($F_1=68.04$, df=1,14, p<.0001; $F_2=10.99$, df=1,4, p=.0295; Min F'=9.46, df=1,5, p<.05). Indeed every Subject got at least one test item correct and the overall success rate was about 41%, much more than would have been expected if Subjects were making random choices among the 16 toys. The children's results were like the adults' in earlier experiments in that they were very consistent across listeners but less so across words.

Nonetheless this pilot does not solve the problem imposed by the results of Experiments 1 and 2: children may do very well on those child-addressed words which are highly intelligible to adults, but we know from the earlier experiments that such words are quite rare and therefore unlikely to make parentese totally intelligible to young children.

II.C. Experiment 6: Matched Words

II.C.1. Purpose

While Experiment 5 made no attempt to balance speaker sex or child addressee's age across conditions, Experiment 6 was designed to replicate Experiment 2: it compared tokens of the same word addressed to either addressee. Incidentally, Experiment 6 also tested whether slightly longer experimental sessions could be run satisfactorily.

II.C.2. Method

The materials were composed of one pair of object names from the speech of each of the twelve parents in the original corpus. As in Experiment 2, one member of each pair had been addressed to the child, the other to the adult. These 24 words were divided into three groups of eight words each, four originally spoken to children, four to the adult, but no Group contained both members of any pair. Each Group was recorded on a separate tape and all three tapes began with the same two practice stimuli read as citation forms by a female speaker of Scottish English. The materials and their sources in the corpus are detailed in Appendix C.

Eighteen three-year-old children (mean age 43.2 months) attending day nurseries in Edinburgh served as *S*s. Two additional *S*s had been eliminated at the beginning of their testing sessions because they could not choose the items represented by the citation forms. Prior to testing, all children were familiarized, in the manner described in Section II.B.2, with a set of toys which included the twelve named by the stimuli and six others. All the children tested knew all the names.

Six children heard each of the three tapes so that every child heard words to both addressees but none heard a word and its mate.

The apparatus and procedure were identical to those described in Section II.B.2.b above.

II.C.3. Results and Discussion

Subjects correctly identified an average of 1.6 words (40%) to the adult and 1.2 (30%) to the child. The difference was not significant either by Subjects or by word pairs in t-tests.

While the results here were not encouraging, they did not strongly contradict the results of Experiment 5: in both, correct responding was in the same range and in both the Addressee effect failed to reach significance at the .05 level. The failure of either trend to reach significance meant that it was not necessary to be particularly concerned about the reversal in direction. The trend in Experiment 6 was the weaker one and it was not clear whether this experiment revealed a tendency for child Subjects to perform like adults in producing reduced Addressee effects in matched pairs or whether the outcome was due to the new population of children tapped here. The Subjects for Experiment 5, chosen from the Psychology Department Nursery, were well used to participating in experiments in which relative strangers asked them to play unfamiliar games. But those in Experiment 6 came largely from Lothian Region Nursery Schools and Classes and had not overcome their initial shyness by their second meeting with the Experimenters. The more elaborate design and procedure of Experiment 7 were intended partly to ascertain the effect of matching stimuli across addressee and to make the results more trustworthy by reducing the reserve of the Subjects.

III. Experiment 7: The Effects of Addressee and Context for Child and Adult Subjects

III.A. Purpose

Though it deals with the problems raised by the foregoing pilot studies, Experiment 7 was intended principally to test the set of Perception Hypotheses outlined in Section I of this chapter, hypotheses which suggest how young children might manage to recognize more than the occasional word in speech addressed to them.

The first of these proposes that children are particularly expert acoustic processors and therefore may be insensitive to the difference in intelligibility which adults perceive between words uttered in isolation and words produced in conversation. Experiment 7 presents all stimuli both as Conversational Forms (word tokens segmented from the stream of parents' speech) and as Citation Forms (words read from a list) and asks both child and adult Subjects to identify them. If children really are unaffected by differences reflected in adults' responses, they will recognize Conversational Forms as often as Citation Forms, and they will do better than adults on the former.

The second hypothesis suggests that there actually is a special relationship between parentese delivery and small children's speech perception, such that child Subjects may fail to reflect the Addressee effect which adult Subjects displayed in Experiments 1 and 2. Experiment 7 uses word tokens isolated from speech to a child or to an adult. If this hypothesis holds, adult listeners will once again find words addressed to children the less clear group while children may display either no Addressee effect or a trend in favor of speech addressed to other young children.

A third possibility transfers the center of interest from the acoustic signal to its non-linguistic context. If children are capable of integrating acoustic information with some account of their physical surroundings, they can scan the objects and events present during conversations to provide candidate readings for what might otherwise be unrecognizable word tokens in their parents' speech. To see whether this strategy is used, Experiment 7 presents concrete nouns as stimuli while familiar examples of the named objects are either visible or hidden from view. If extra-linguistic context can be used to supplement acoustic shape, the Visible condition should prove appreciably better than the Hidden.

III.B. Method

III.B.1. Materials

The stimuli, once again all object names[2], were of two sorts. The first were 96 Conversational Forms, eight from the speech of each of the 12 parents contributing to the corpus, each word isolated from its sentence context by the segmentation method described in Chapter 3, Section III. Of these, 48 formed Matched Pairs (one token of the word to the child, the other to the adult), while the others were Nonmatched Words also divided equally between addressees. None of the Conversational Forms were randomly selected. Instead, they were chosen from the corpus tapes because they might be readily represented by a small toy and because they were free from extraneous noise. While the stimuli did not represent 72 different lexical items, there was no duplication within the set of stimuli heard by any one *S*.

The second sort of stimuli were Citation Forms, tokens of the Conversational words read from a list by a speaker of the same sex and age range as the parent who had produced the original token. There were 72 Citation Forms, one for each of the 48 Nonmatched Words and one for each of the 24 Matched Pairs. Citation Forms were also segmented from their contexts so that they would show the same abrupt onsets and offsets as the Conversational Forms.

III.B.2. Design

Stimuli were divided into eight presentation Groups, each containing twelve Conversational and twelve Citation Forms. The Groups were created by dividing pairs of Matched and Nonmatched Conversational Forms into eight sets each and pairing the sets in the manner laid out in Appendix D.1. The twelve Conversational Forms in each Group represented half the informants, but both levels of Addressee (Child, Adult) and Word Type (Matched, Nonmatched). To these were added twelve Citation Forms, those corresponding to the six Nonmatched Words in some other Group, and those corresponding to the six lexical items from the Matched Pairs of two other Groups.

Each of these Groups was divided between two tapes, each containing two halves. Each half tape contained two Citation Forms followed by six Conversational Forms and a third Citation Form. All the Conversational Forms in a Group were presented once on each of its tapes, while all the Citation Forms appeared only once over the two. Every stimulus was repeated three times in succession at roughly five-second intervals. Appendix D.2 illustrates the form of the tapes.

Each *S* was tested in two Sessions, one tape per Session. Half of each tape was presented in each Context condition (Visible, Hidden) in such a way that Context and Order (Session 1, Session 2) were counterbalanced. Beyond this point, the designs for child and adult *S*s differed.

As Appendix D.3 shows, Child *S*s were distributed among four Conditions per Group (a-d) so that each Conversational Form was heard in each combination of Context (Visible, Hidden) and Order (Session 1, Session 2) but no stimulus was heard twice in the same Context. For both Word Types taken together each child *S* formed a complete replicate, nested within Presentation Group (8) and having Addressee (2), Context (2), and Session (2) as repeated measures. For either of the Word Types taken separately, however, each child formed only a half-replicate, while each word continued to be balanced for Context and Order[3].

Adult *S*s, on the other hand, were assigned to only one Condition per Group, counterbalancing over the whole experiment rather than within each Group. Each *S* was still a whole replicate if both Word Types were combined and a half otherwise, but now the complementary half-replicate belonged to another Group. In this case, half the words in each Group appeared in each of the combinations of Context and Order. Appendix D.3 also describes this design.

III.B.3. Subjects

III.B.3.a. Children.

Sixty-four children (34 girls and 30 boys) with mean age 41.4 months (s.d.=6.1 months) served as *S*s. All attended nursery school or classes in Edinburgh. The *S*s were assigned to Groups and Conditions pseudo-randomly, two to each of the four Conditions in each Group.

III.B.3.b. Adults.

Forty members of the Edinburgh University community served as adult controls, five in each Group. All Subjects in a Group belonged to a single condition.

III.B.4. Procedure

III.B.4.a. Children

While modelled on the technique of Experiments 5 and 6, the method here made certain changes to both familiarization and testing procedures.

To enable the *S*s to become better acquainted with the *E*s, two modifications were made. First, the *E*s spent several days visiting each nursery and playing with the children before approaching any *S*s individually. And second, *S*s were familiarized with the full set of toys used in the experiment, because the introduction to the toys was carried out, like many other nursery activities, with groups of three to six children. If any child in a group could not name a toy when it was drawn from the toy bag, all the children were given practice with the word. By blending into the nursery scheme of group activities, this system gave the *E*s a better chance of being accepted by the children as nothing more threatening than two new teachers.

The differences in test procedure were matters of design. First, as each of the eight Presentation Groups would hear different words, each used a different set of 25 toys: nine for the Conversational Forms, twelve for the Citation Forms, and four items whose names appeared among the stimuli for other Groups. Second, to accommodate the two Context conditions, *S*s were always instructed first to name and then to retrieve the objects requested by the puppet. In the Visible condition, all the objects were set out on the lid of a large blue box. In the Hidden condition, the objects were inside the same box when each stimulus was presented and *S* had to name the requested item before opening the box to find it. *E* recorded both the name and the choice on prepared protocol sheets. Third, each *S* was tested in two Sessions separated by at least 24 hours[4].

III.B.4.b. Adults

The adult *S*s were run in a recording studio in groups of five and received both Sessions on the same day. They were told that they were controls in an experiment on children and were to write down the words they heard. They were shown the appropriate 25 toys before the first session. In the Visible condition, the toys were set out on top of a table around which the Subjects were seated. In the Hidden condition, the toys were inside a closed box.

III.C. Results

III.C.1. Scoring

Adults' responses were scored correct if they were exact transcriptions of the stimuli. For child Subjects, however, the toy chosen provided the scorable response. The choices did provide more evidence of correct responding than the verbal responses (by about 3%), but not so much so that it could be concluded that the two were different processes. While 6% of the correct choice responses were not accompanied by any verbal response, more than 99% of the verbal responses which did accompany the correct choices were also correct. This was very much not the case for incorrect choice responses: only 3% of these were accompanied by correct verbal responses, 62% by incorrect verbal responses, and 35% by no verbal responses at all. It would seem then that the use of choice responses here enables us to distinguish between occasions when the child could and could not identify the stimulus.

III.C.2. Contrasting Citation and Conversational Forms

Citation Forms were included in the present experimental design to show whether children were in any way subject to the decrease in intelligibility between words in lists and words in sentences. The results show quite clearly that they are.

Before we discuss these results,however, a word about the analyses is in order. Since the Citation Forms were not the primary object of interest in Experiment 7, errors which crept into the execution of the experimental design for these words were not put right. These produced so many missing cells in that design that cell-filling procedures were not practical. In fact, by-Subjects analyses of the Citation to Conversational contrast would have to be either extremely unbalanced with respect to the particular materials in each stimulus class or limited in N to a disabling degree if balance were reestablished by discarding some data. Therefore, only by-materials analyses were run, each on a limited set of words for which the balanced design was fulfilled. Since effects have generally been less marked by materials than by Subjects in this experimental paradigm, we may suppose that by-Subject analyses should have shown at least the results detailed below.

The first of the comparisons concerned Citation and Conversational forms of 40 Nonmatched Words over both presentations. An ANOVA was run for Form (Citation, Conversational) x Addressee (Adult, Child) with lexical items as the only random effect and with Form within and Addressee between lexical items. The only significant effect was that for Form (F_2=36.31, df=1,38, p<.0001): considerably more Citation (79.1%) than Conversational (45.6%) Forms were correctly identified (Figure 4.1).

A pair of analyses portrays similar results for first presentations (Figure 4.2). For the same 40 Nonmatched Words, Citation Forms, at 80.63% correct, were again more intelligible then their Conversational counterparts at 44.38% (F_2=35.56, df=1,38, p<.0001). Citation Forms for 18 Matched Words (72.25%) were clearer than either of the corresponding Conversational Forms (39.58%

to Adult, 29.86% to Child) (Scheffé tests at $p<.01$ within the three-level Form effect: $F_2=13.22$, $df=2,34$, $p= 0001$). These results argue that what happens to the pronunciation of a word in speech makes it more difficult for a child to recognize that word.

The notion that young children are not expert acoustic processors is further supported by the comparison between children's and adults' performance. Figure 4.3 shows that children were considerably less successful than adults at recognizing Conversational Forms. A comparison which will be described more fully below (Section II.C.3.b.i.) showed that when the two groups of listeners worked on the same stimuli in the same conditions, the adults were the more competent to a highly significant degree (80.4% vs.38.8%: $F_1=193.58$, $df=1,28$, $p<.0001$; $F_2=74.27$, $df=1,64$, $p<.0001$; Min $F'=53.68$, $df=1,92$, $p<.0001$).

In fact, children's performance in this experiment was very much in the range of adults' in Experiments 1 and 2, as the additional points in Figure 4.2 demonstrate. Since the present experiment demanded selection of responses from a very small set, children might be expected to do even worse when confronted, as the adults in those experiments were, with choices from their entire lexicon.

III.C.3. Effects within Conversational Forms

III.C.3.a. Initial Analyses

Since the results of Experiments 5 and 6 had suggested that Matched and Nonmatched Words would perform differently and since children and adults had been run under different designs, the initial analysis of Conversational Forms was conducted via four pairs of ANOVAs, one pair for each com-

FIGURE 4.1

Experiment 7 (Child and Adult Subjects). The Intelligibility of 40 Nonmatched Words as Citation and Conversational Forms, Expressed as Percentage of Child Subjects Correct.

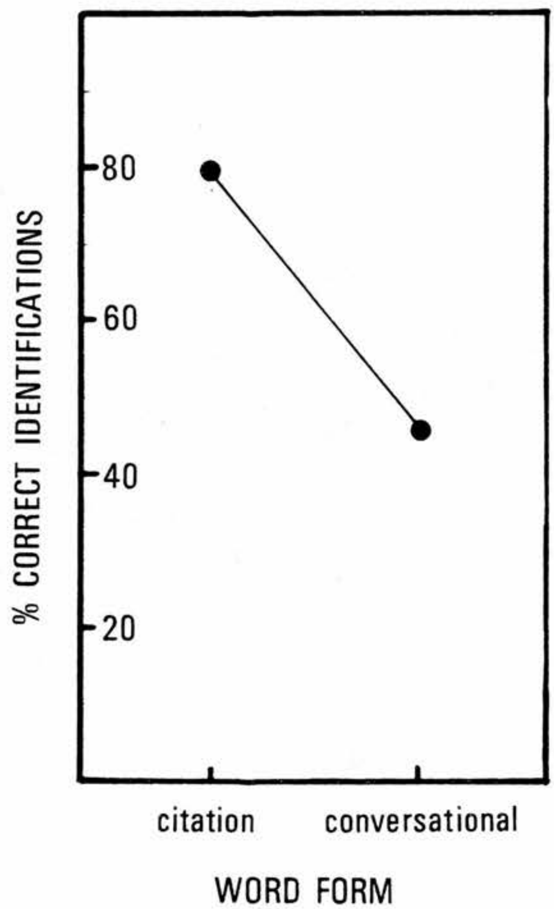
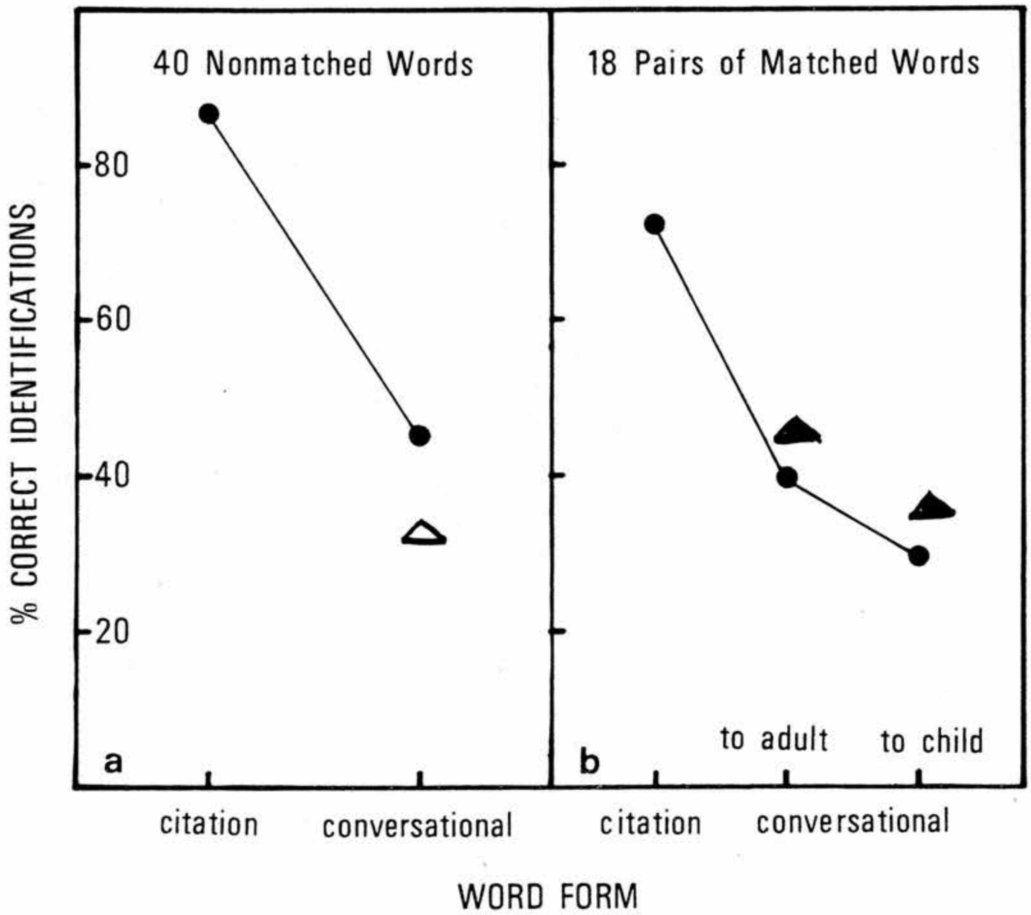


FIGURE 4.2

Experiment 7 (Child and Adult Subjects). The Intelligibility of Citation and Conversational Forms on First Presentation as Percentage of Child Subjects Correct.

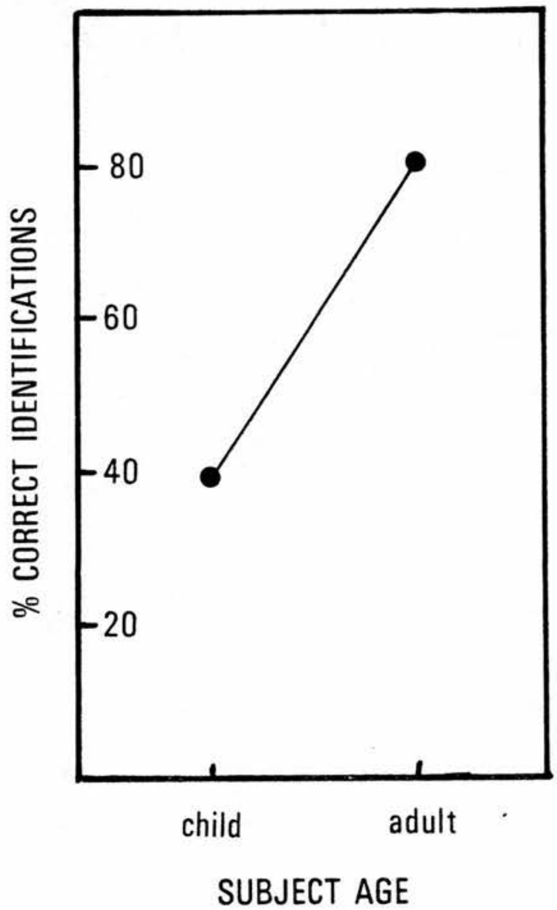


Key:

- ● Child $\underline{S}$s, Expt. 7
- △ Adult $\underline{S}$s, Expt. 1
- ▲ Adult $\underline{S}$s, Expt. 2

FIGURE 4.3

Experiment 7 (Child and Adult Subjects). The Effect of Subject Age Expressed as Percentage of Judgements Correct, First Presentations Only.



bination of Word Type and Subject Age. One of each was by word tokens and the other by Subject replications, totalling half the number of Subjects. All ANOVAs had the design Addressee (Child, Adult) x Context (Hidden, Visible) x Order (First Presentation, Second Presentation).

The results can be examined in Appendix D.4. Figure 4.4 outlines the major finding: in three of the four ANOVA pairs, only Order of Presentation produced significant effects both by Subjects and by materials. For child Subjects, second session scores were better than first both for Matched (F_1=11.65, df=1,24, p<.005; F_2=8.71, df=1,32, p=.0059; Min F'=4.98, df=1,80, p<.05) and Nonmatched Words (F_1=12.00, df=1,24, p<.005; F_2=10.72, df=1,32, p<.0025; Min F'=5.66, df=1,78, p<.025). For adults, the difference reached significance only for Nonmatched Words (F_1=11.63, df=1,16, p<.005; F_2=4.17, df=1,16, p=.057).

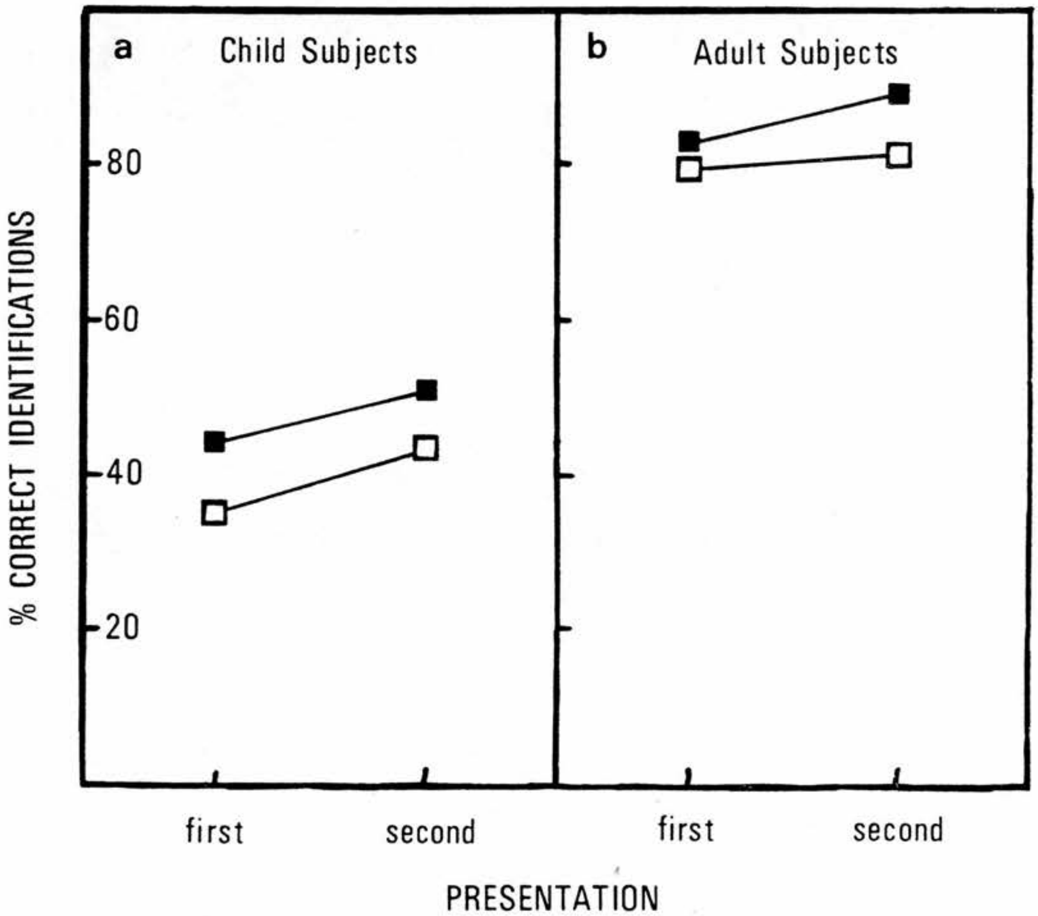
Of the other two main effects, only Addressee yielded any significant F-ratios. Figure 4.5 shows that child and adult Subjects both did better on Nonmatched Words to children than on their counterparts to the adult (Children: F_1=6.68, df=1,24, p<.025; F_2<1; Adults: F_1=12.20, df=1,16, p<.005; F_2<1). Only adults showed a similar effect on Matched Words (F_1=5.63, df=1,16, p=.05).

The effects for Context, while in favor of the Visible condition, did not reach significance. For adult listeners, however, there are interactions of context with Order (F_1=13.80, df=1,16, p<.005; F_2=1.27, n.s.) and with Order and Addressee (F_1=8.52, df=1,16, p=.01; F_2=1.76) within the Nonmatched Words. Visible words in the second session were better than any others (by Scheffé test at p<.05).

To this list should be added sundry interactions with Group in all ANO-

FIGURE 4.4

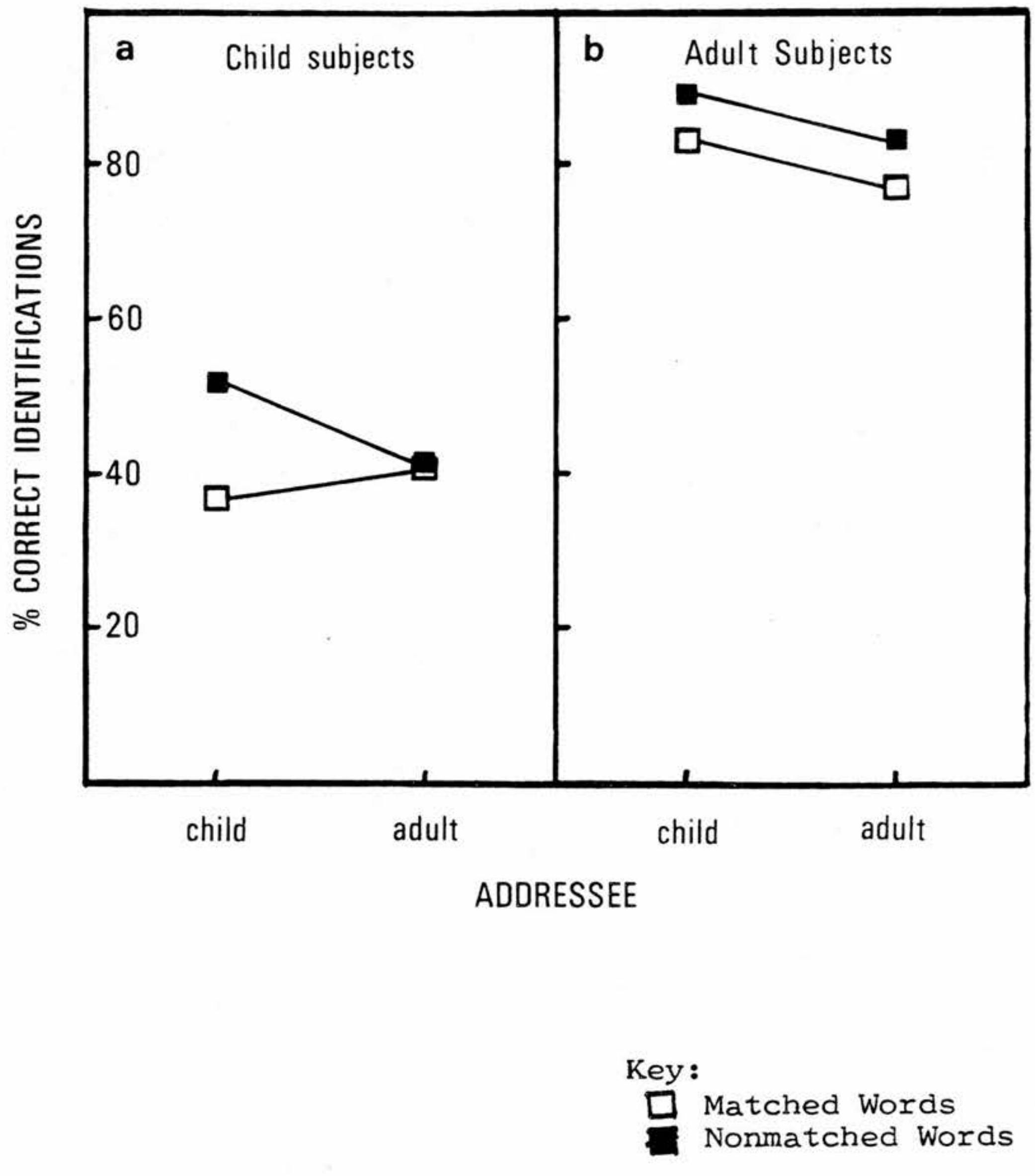
Experiment 7 (Child and Adult Subjects): The Effects of Order of Presentation on the Intelligibility of Conversational Forms for Child and Adult Listeners.



Key:
□ Matched Words
■ Nonmatched Words

FIGURE 4.5

Experiment 7 (Child and Adult Subjects). The Effect of Addressee on the Intelligibility of Conversational Forms for Child and Adult Listeners. Both Presentations.



VAs. When considered in the light of the rarity of by-materials effects, these may indicate only the sizable variance among stimuli: if the small set of words addressed to adults within one Presentation Group, for example, happened to be much more intelligible than those in some others, there could well be a Group x Addressee interaction.

Taken as a whole, then, the experiment yielded few substantial results. The by-Subjects tendency toward better performance on words spoken to children held for both Child and Adult listeners. The effect of Context *per se* was small. And dominating all these were the consistent failure of effects by materials and the very robust effect of Order.

If the Order effect meant that Subjects were learning the stimuli or memorizing their interpretations of them, then second session scores should represent not only the effects of Context and Addressee but also the way in which these factors interacted with the Subject's ability to learn about a particular word shape. For the second half of the data, these interactions might be masking the effects which the experiment was designed to explore. To expose the desired information, the data were reanalyzed in two independent ways. In one, first presentations alone were examined. In the other, only the difference between second and first presentation scores, a difference which we might wish to call learning, was scrutinized. These analyses, in Sections III.C.3.b.i and ii below, provide a more revealing account of the results.

III.C.3.b. Subsequent Analyses

III.C.3.b.i. First Presentation

Each ANOVA in this section includes data for both child and adult Subjects and for the first presentations of both Matched and Nonmatched Words. Data were combined here in order to permit direct investigation of Subject

Age and Word Type.

For the by-Subjects analysis, each Subject was paired with his complementary half-replicate. As all the adult Subjects in any Presentation Group received only one of the two first presentation conditions (Adult Hidden, Child Visible or Adult Visible, Child Hidden for Matched Words and the other for Nonmatched), each adult Subject had to be paired with a Subject in another Group. Accordingly, Subjects in Groups with complementary conditions were combined to form four Composite Groups of five replicates (Subject pairs) each. To produce the same design for child Subjects, only the results in the cells filled by the adult design were retained and the appropriate half of the Subjects were paired with their complementary half-replicates to form the same four Composite Groups as were used for the adults. These Groups, however, contained four replicates each. The resulting unequal cell-size ANOVA included Subject Age (Child, Adult) x Word Type (Matched, Nonmatched) x Addressee (Child, Adult) x Context (Hidden, Visible) x Composite Group (I-IV). Replicates were nested within Group and Subject Age and crossed with the other variables[5].

For the by-materials analysis, analogous arrangements were made. As the two Subject Ages were represented by different maximum scores, percentages replaced raw scores. The results are summarized in Table 4.2.

Subject Age. Section III.C.2 and Figure 4.3 above have already recorded one major outcome of this analysis: children were substantially less competent at the task than adults. While the child Subjects correctly identified an average of 1.17 out of 3 words per cell, adults recognized 2.41.

Addressee. The predicted match between child listeners and parentese also fails to materialize in any form that resembles a *deus ex machina*. The

TABLE 4.2

Experiment 7. Principal Results for First Presentations of Matched and Nonmatched Conversational Forms

	Effect	Cell Means (out of 3 words)	F_1	F_2	Min F'
1.	Subject Age	Children: 1.164 Adults: 2.413	193.58 (1,28) p<.0001	74.27 (1,64) p<.0001	53.68 (1,92) p<.0001
2.	Word Type	Matched: 1.785 Nonmatched: 1.931	4.06 (1,28) p=.0535	<1	-
3.	Addressee	to Adult: 1.757 to Child: 1.958	10.66 (1,28) p=.0029	1.72 n.s.	-
4.	Context	Hidden: 1.840 Visible: 1.875	1.31 n.s.	<1	-
5.	Group	'I' 1.607 'III' 1.972 'II' 1.995 'IV' 1.846	4.20 (3,28) p=.0142	1.60 n.s.	-
6.	Addressee X S Age	Children / Adults to Adult: 1.078 / 2.300 to Child: 1.250 / 2.525	<1	<1	-
7.	Addressee x Word Type	to Adult / to Child Matched: 1.750 / 1.820 Nonmatched: 1.764 / 2.097	6.24 (1,28) p=.0186	<1	-
8.	Addressee x Word Type x S Age	Children: to Adult / to Child; Adults: to Adult / to Child Matched: 1.156 / .969 / 2.225 / 2.500 Nonmatched: 1.000 / 1.531 / 2.375 / 2.550	10.93 (1,28) p=.0026	2.53 n.s.	-
9.	Context x S Age	Children / Adults Hidden: 1.078 / 2.451 Visible: 1.250 / 2.375	8.53 (1,28) p=.0068	1.10 n.s.	-
10.	Context x Addressee	to Adult / to Child Hidden: 1.903 / 1.778 Visible: 1.611 / 2.139	27.38 (1,28) p<.0001	4.71 (1,64) p=.0336	4.03 (1,82) p<.05

<u>TABLE 4.2</u> (continued)

11.	Context x Addressee x S Age		Children		Adults				
			to Adult	to Child	to Adult	to Child	6.77	2.07	-
		Hidden:	1.250	.906	2.425	2.475	(1,28)		
		Visible:	.906	1.594	2.175	2.575	p=.0147	n.s.	
12.	Word Type x Context x Addressee		Matched		Nonmatched				
			to Adult	to Child	to Adult	to Child	5.31	2.28	-
		Hidden:	1.750	1.696	2.060	1.860	(1,28)	n.s.	
		Visible:	1.750	1.940	1.470	2.330	p=.0289		
13.	Context x Group		Hidden		Visible		10.20	1.04	-
			'I' 1.527	'III' 1.999	'I' 1.685		(3,28)	n.s.	
			'II' 2.275	'IV' 1.722	'III' 1.943		p=.0001		
					'II' 2.025				
					'IV' 1.971				
14.	Context x Group x S Age		Children		Adults				
			Hidden	Visible	Hidden	Visible	3.42	<1	-
		'I'	0.812	0.875	2.200	2.350	(3,28)		
		'II'	1.185	1.500	2.600	2.500	p=.0306		
		'III'	1.437	1.062	2.700	2.400			
		'IV'	1.125	1.562	2.300	2.300			
15.	Word Type x Addressee x S Age x Group		Children:						
			Matched		Nonmatched		3.47	<1	-
			to Adult	to Child	to Adult	to Child	(3,28)		
		'I'	0.875	.375	.625	1.250	p=.0294		
		'II'	1.250	1.250	1.000	1.875			
		'III'	0.375	1.750	1.250	0.750			
		'IV'	1.375	1.250	1.125	1.375			
			Adults						
		'I'	1.900	2.500	2.400	2.300			
		'II'	2.200	2.400	2.900	2.600			
		'III'	2.500	2.800	2.100	2.800			
		'IV'	2.300	2.300	2.100	2.500			
16.	Context x Addressee x Group		to Adult		to Child				
			Hidden	Visible	Hidden	Visible	8.74	2.44	
		'I'	1.444	1.610	1.610	1.777	(3,28)	(3,64)	
		'II'	2.000	1.777	2.555	2.275	p=.0003	p<.10	
		'III'	2.333	1.499	1.666	2.388			
		'IV	1.722	1.833	1.722	2.110			

TABLE 4.2 (continued)

17.	Context x Addressee x S Age x Group		Children:				5.67 (3,28) p=.0036	< 1	-
			to Adult		to Child				
			Hidden	Visible	Hidden	Visible			
		'I'	.500	1.000	1.125	.750			
		'II'	1.250	1.00	1.125	2.000			
		'III'	2.000	.375	.875	1.750			
		'IV'	1.500	1.250	.750	1.875			
			Adults:						
		'I'	2.200	2.100	2.200	2.600			
		'II'	2.700	2.400	2.500	2.600			
		'III'	2.700	1.900	2.700	2.900			
		'IV'	2.100	2.300	1.500	2.300			
18.	Word Type x Context x Addressee x Group		Matched:				8.51 (3,28) p=.0004	2.36 (3,64) p=.08	-
			to Adult		to Child				
			Hidden	Visible	Hidden	Visible			
		'I'	1.222	1.666	1.555	1.555			
		'II'	2.000	1.555	2.666	2.444			
		'III'	2.222	1.222	1.444	2.111			
		'IV'	1.444	2.333	2.000	1.666			
			Nonmatched:						
		'I'	1.666	1.555	1.666	2.000			
		'II'	2.000	2.000	2.444	2.111			
		'III'	2.464	1.700	1.888	2.666			
		'IV'	2.000	1.333	1.444	2.555			

nature of the Addressee effect is initially elucidated by its interactions with Subject Age and Word Type.

Over both sets of listeners, the words spoken to children were the more intelligible, but the result is significant only by Subjects (F_1=10.66, df=1,28, p=.0029; F_2=1.79, df=1,64, p=.19). While the virtual absence of a Subject Age x Addressee interaction (F_1=.19, F_2=.01) would seem to show an equal propensity in children and adults, there is an interaction of Subject Age x Addressee x Word Type (F_1=10.93, df=1,28, p=.0026; F_2=2.53, df=1,64, p=.117). The two sets of listeners produced their overall Child Advantage in different ways (Figure 4.6). Adults displayed the same trend for both Matched and Nonmatched words (p<.05 in both cases). But children produced their overall Addressee effect via a significant Child Advantage in Nonmatched Words and a significant (but smaller) child disadvantage for Matched Pairs (Scheffés at p<.01). It is difficult to argue that parentese is tailored to the child's ear when the adults more consistently favored words spoken to children and when the children on occasion seemed to find parentese pronunciation the more difficult to understand.

There is some reason to believe that such preference as the child listeners had was due to a small set of stimuli. As the Child Advantage in the Nonmatched Words failed to reach significance by materials, we might conclude that only some of the Nonmatched Words to children were especially intelligible. Table 4.3 shows that these were probably not the same words for adult and child Subjects: although the numbers of children and adults getting particular words correct do correlate positively, none of the r-values is large enough to differ significantly from zero. In fact, to understand what made these words intelligible for children, we must examine the relationship between Addressee and Context.

FIGURE 4.6

Experiment 7 (Child and Adult Subjects). The Interaction of Addressee x Subject Age x Word Type Expressed as Percentage of Judgements Correct, First Presentation only.

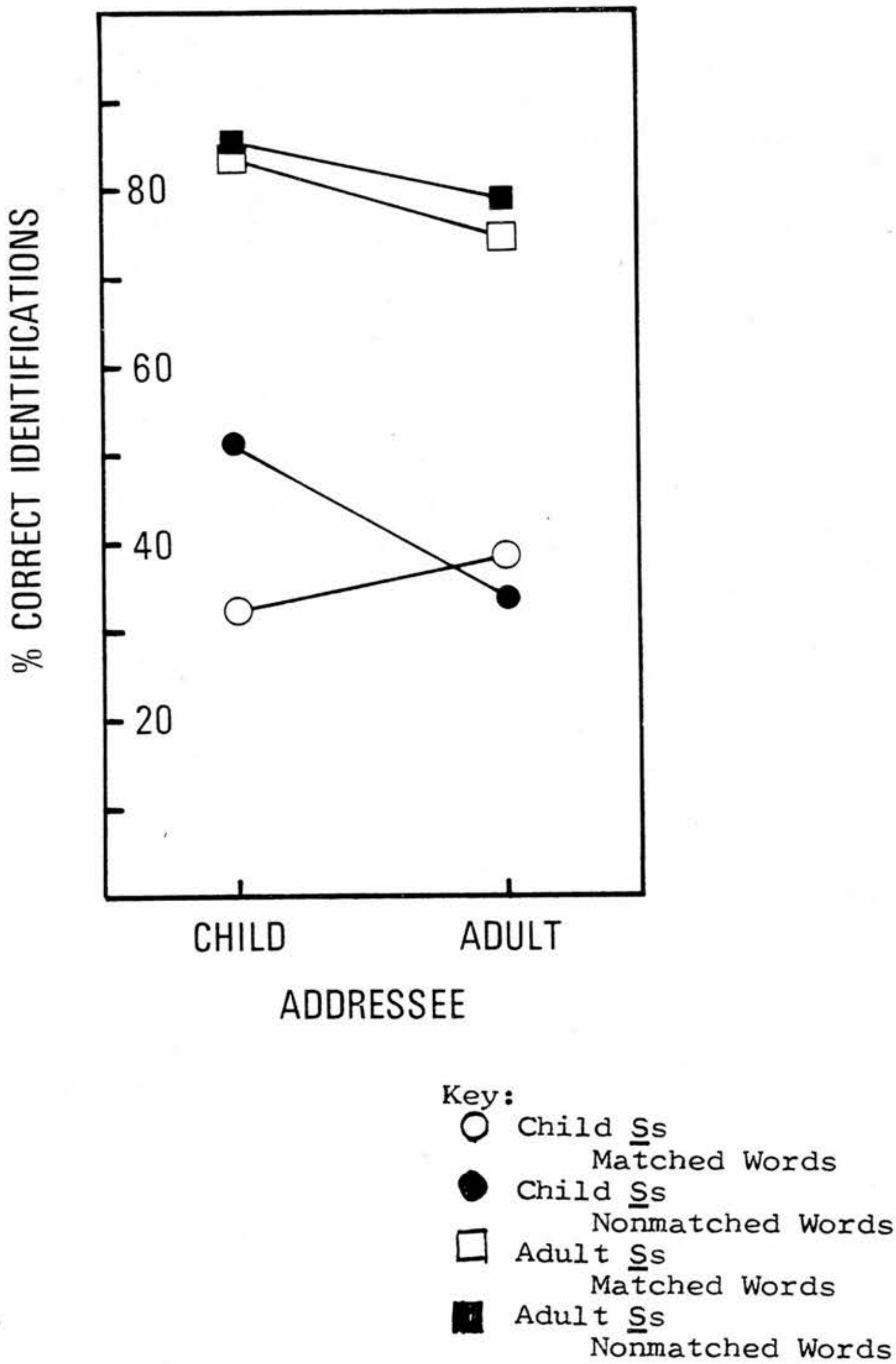


TABLE 4.3

Experiment 7. Correlations between Raw Numbers of Adults and Children Correct on First Presentations.

Stimulus Subset	Correlation
All words	.044
Words to Children	.064
Words to adults	.091
Matched words	.140
Nonmatched words	.020
Visible Referents	.101
Hidden Referents	.082

Context. The effects of Context on children's performance tend to confirm the hypothesis that children can make use of extra-linguistic information in word recognition. In addition, they suggest a relationship between the Context condition and the Addressee effect.

The availability of visual context appears to have benefitted only the child listeners (Scheffé test by Subjects at $p<.05$ within Context x Subject Age: $F_1=8.53$, df=1,28, p=.0068; $F_2=1.10$, df=1,64, n.s.). Adult Subjects, whose scores were, of course, much higher, showed no such tendency (Figure 4.7).

Moreover, the effect of the Visible condition appears to be to support the Child Addressee Advantage. As Figure 4.8 shows, when both categories of listener are considered, there is a Child Addressee Advantage only in the Visible condition and a Visible Referent Advantage only for words originally spoken to children (Scheffé tests at .05 and .01 respectively by Subjects in Context x Addressee: $F_1=27.38$, df=1,28, $p<.0001$; $F_2=4.71$, df=1,64, p=.03; min $F'=4.03$, df=1,82, $p<.05$). In fact, words to adults presented with referents Visible were less clear than their Hidden counterparts ($p<.01$). When the results are subdivided by Subject Age (Figure 4.9), the perverse Hidden condition advantage for words to the adult no longer reaches significance, but the Child Addressee Advantage is still a function of the Visible condition ($p<.05$ for children and for adults within Context x Addressee x Subject Age: $F_1=6.77$, df=1,28, p=.0147; $F_2=2.07$, df=1,64, p=.16).

The association might be taken a step further. It will be recalled from Figure 4.6 that child listeners showed a Child Addressee Advantage only within Nonmatched Words and that for both children and adults the Nonmatched Words to children were the most intelligible. We can see from Figure 4.10 that this Child Advantage was stronger in the Visible condition. In fact, only in this condition is it significant as a simple effect (Scheffé test at p<.01 by Subjects within Context x Addressee x Word Type: $F_1=5.31$, df=1,28, p=.03; $F_2=2.28$, df=1,64, p=.13). It seems that the visual context can contribute to the intelligibility of different word tokens to varying degrees and that it was particularly helpful for the Nonmatched Words addressed to children[6].

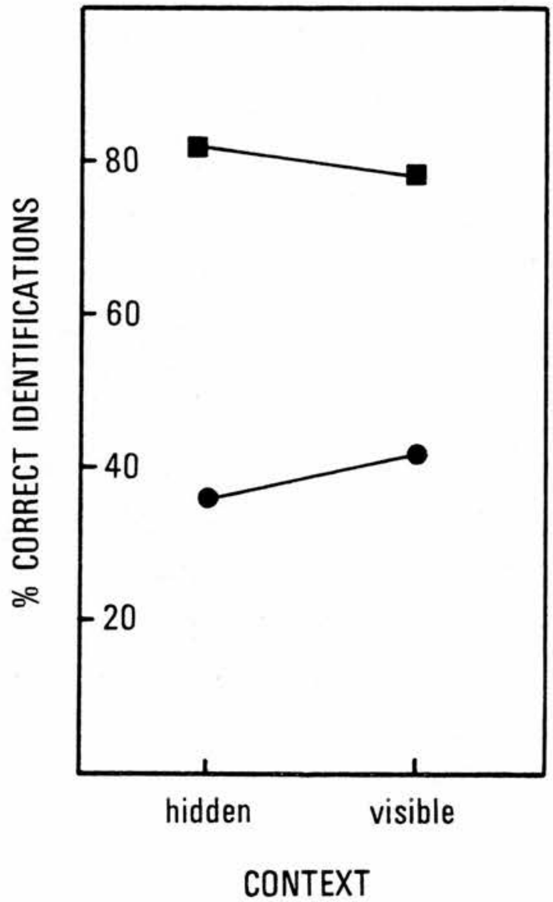
III.C.3.b.ii. Learning Effects

The differences between first and second presentation scores were analyzed separately for child and adult Subjects, because there was reason to believe that the latter were contaminated by a ceiling effect. Adults' second exposure to stimuli often produced perfect scores. As might be expected, therefore, the higher a word's first presentation score was for adult listeners, the lower was its improvement between presentations (r=-.59, t=-4.99, df=90, p<.0005). And the relationship seemed to account for a sizeable part of the overall variance (35%). For children, on the other hand, the relationship between first presentation scores and learning (r=-.18, t=-1.26) was not significant and would account at best for about 3% of the variance. Hence the 'learning' effects for children and adults probably have different relationships to a maximum level of performance.

Child Subjects. For each child Subject the first presentation score for words to each Addressee within each Word Type was subtracted from the second presentation score and Subjects were paired to form replicates. As all the cells of the child design could now be used, replicates were composed of Subject pairs within a single Presentation Group and there were four replicates per Group. Replicates were crossed with Word Type, Addressee, and Context (Vis-->Hid vs Hid-->Vis). Analogously calculated learning scores for words provided the data for an ANOVA with words nested within combinations of Addressee, Group, and Word Type and crossed with Context. The principal

FIGURE 4.7

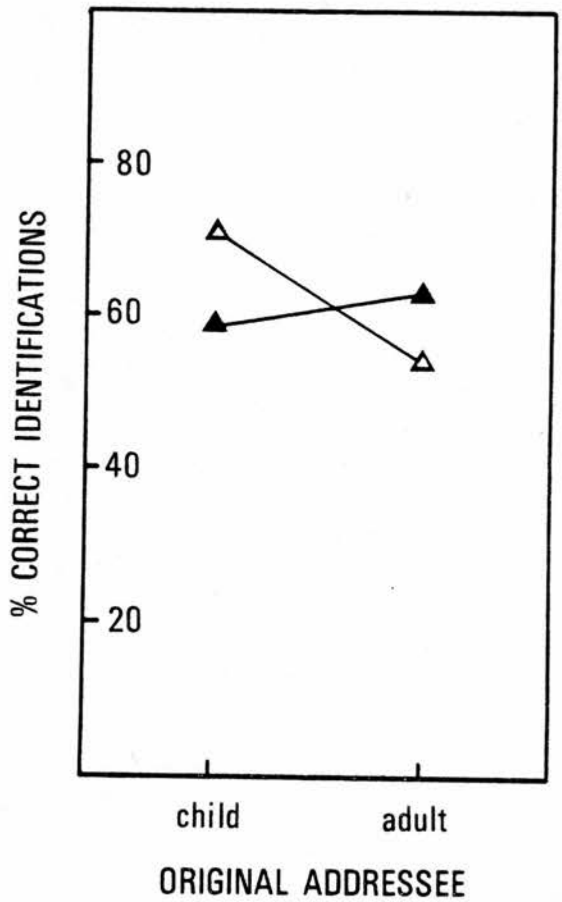
Experiment 7 (Child and Adult Subjects). The Interaction of Context and Subject Age Expressed as Percentage of Judgements Correct, First Presentations Only.



Key:
● Child Ss
■ Adult Ss

<u>FIGURE 4.8</u>

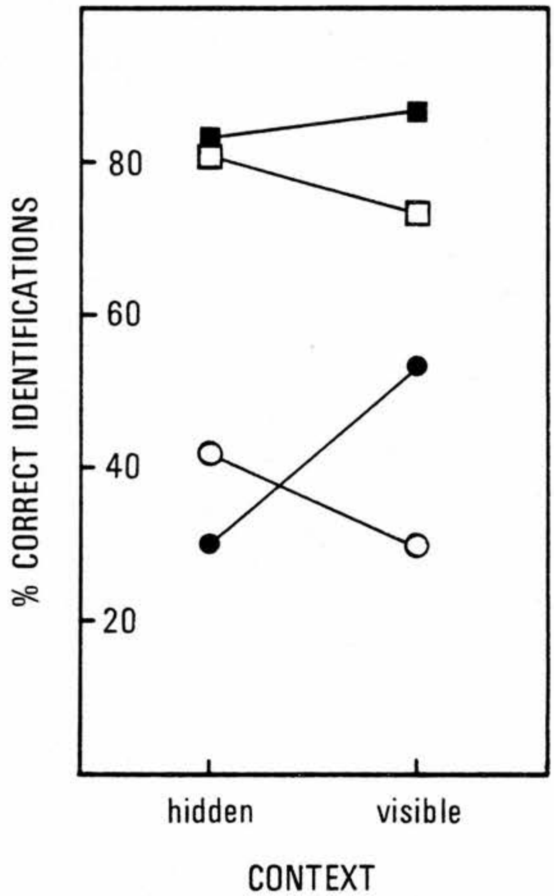
Experiment 7 (Child and Adult Subjects). The Effect of Context on the Addressee Effect Expressed as Percentage of Judgements Correct, First Presentations Only.



Key:
▲ Hidden
△ Visible

FIGURE 4.9

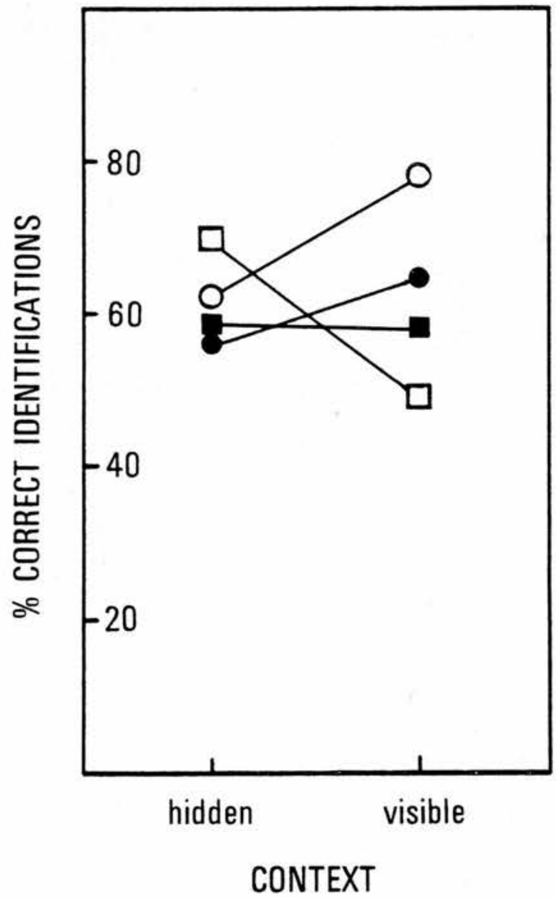
Experiment 7 (Child and Adult Subjects). The Interaction of Context, Addressee, and Subject Age Expressed as Percentage of Judgements Correct, First Presentations Only.



Key:
- ● Child Ss, words to Child
- ○ Child Ss, words to Adult
- ■ Adult Ss, words to Child
- □ Adult Ss, words to Adult

FIGURE 4.10

Experiment 7 (Child and Adult Subjects). The Interaction of Context, Addressee, and Word Type, Expressed as Percentage of Judgements Correct, First Presentations Only.



Key:
● Matched Words to Child
■ Matched Words to Adult
○ Nonmatched Words to Child
□ Nonmatched Words to Adult

results are summarized in Table 4.4.

The table shows that there was a significant learning effect overall: the mean of .21 words (17.8% of the first presentation mean) differs significantly from zero. There was, however, no difference in learning scores by Addressee and there were different Addressee trends for each Word Type: Matched Words to children and Nonmatched Words to adults made the greatest gains. These were the categories which had been least intelligible on first presentation and while one might wish to see the learning pattern as a modest ceiling effect, the rest of the interaction does not encourage that view. For instance, Nonmatched Words to children, the best first-presentation cell, should, -- but do not -- , make least progress. At any rate the data show that there is no consistent tendency for stimuli originally addressed to one or other addressee to be more readily mastered.

More notable, however, was the fact that Hid-->Vis showed three times as much learning than Vis-->Hid (F_1=4.94, df=1,24, p=.04; F_2=5.44, df=1,64, p=.023; Min F'=2.58, n.s.). Thus the improvement over repetition for any given word now depended on whether a visible referent was added or taken away.

Adult Subjects. Learning scores for adult Subjects were derived in the method described above. Subjects were paired into replicates with Subjects from other Groups, nested five in each of four Composite Groups, and crossed with Addressee, Context, and Word Type. Words were combined into the same Groups, nested within Addressee and Type and Context. As Table 4.4 shows, the learning effect of .14 words (5.6% of the first presentation score) was significantly greater than zero. And though the Context effect followed the children's trend, it was not significant. In fact, within the Context x Addressee interaction (F_1=6.48, df=1,16, p=.022; F_2<1), the positive effects

TABLE 4.4

Experiment 7. Principal Learning Effects for Child and Adults Ss.

S Age	Effect	Cell Means (in words)	F1	F2	min F'
Children	Mean	.211	16.32 (1,24) p<.0005	19.85 (1,64) p<.0001	8.96 (1,64) p<.005
Children	Context	Vis→ Hid: .102 Hid→ Vis: .320	4.94 (1,24) p = .0359	5.44 (1,64) p = .0228	2.58 (1,67) n.s.
Children	Addressee	Adult: .203 Child: .219	F< 1	F< 1	----
Children	Word Type x Addressee	Addr: Adult Child Type: Matched .078 .328 Nonmatched .328 .109	5.82 (1,24) p = .0239	4.28 (1,64) p = .0426	2.46 (1,57) n.s.
Children	Context x Addressee	Addr: Adult Child Context: Vis --> Hid .047 .156 Hid --> Vis .359 .281	2.08 (1,24) n.s.	1.36 (1,64) n.s.	----
Adults	Mean	.138	10.64 (1,16) p = .0049	8.00 (1,32) p = .008	4.57 (1,46) p < .05
Adults	Context	Vis → Hid: .088 Hid → Vis: .188	1.86 (1,16) n.s.	F < 1	----
Adults	Addressee	Adult: .150 Child: .125	F < 1	F < 1	----
Adults	Context x Addressee	Addr: Adult Child Context: Vis → Hid: .200 -.250 Hid → Vis: .100 .275	6.48 (1,16) p = .0216	F < 1	----

of the Hid -->Vis sequence appear only for words spoken to children.

III.D. Discussion

Experiment 7 was designed to answer three questions:

1) Are children such good acoustic processors that they are insensitive to the unintelligibility of word tokens sampled from speech?

2) Do children find words addressed to young children not less, but more intelligible than words spoken to adults?

3) Can children make use of extra-linguistic context to improve their chances of recognizing a word?

The data suggest answers.

First, the results give no support whatever to the view that young children are particularly adept acoustic processors. The child listeners were only half as successful at recognizing word tokens isolated from real conversations as they were at the same words taken from lists (Figures 4.1 and 4.2). And they were markedly less proficient than adults at identifying word shapes without help from linguistic context. Their range of scores, in fact, was most like adults' poor showing in Experiments 1 and 2 where the set of possible interpretations of stimuli was extremely large. So far as we can tell from Experiment 7, then, the degradation of articulation in ordinary speech should prove a hindrance to young children. They are certainly no better at sound-based word recognition than adults.

The second hypothesis yielded more complex data. Although child listeners did show an overall preference for child-addressed stimuli, this was not of a form which sits well with the notion of a lock to key match between children's word recognition and the delivery of parental speech. For one thing, children showed quite the opposite effect, -- better performance on words to adults --, in the Matched Words which entered the first presentation analysis (Figure 4.6). Other accounts of the data reveal exactly the same trend: where it is pronunciation alone that is at issue, children find the version for children somewhat harder to understand. Furthermore, we can hardly claim a special relationship between parentese and the child's ear when the adult controls more consistently favored the words that were meant for children.

Indeed, the Child Addressee Advantage, where it occurred, was only an advantage for some of the words to children. The words responsible were among the Nonmatched Words. We know that only some of these are particularly clear, because the Addressee effect is never significant by materials. And we suspect that the selection has something to do with the Context condition: for the first presentation analysis, the Child Advantage holds only in the Visible condition. Throughout the analyses it is the Visible words to children which are most intelligible. Thus, rather than confirming any general predilection for parentese, this experiment indicates that certain of the words said to them are unusually clear to children and that these appear to be the ones which can profit from the presence of visible denotanda.

The final hypothesis, that children can use extra-linguistic information to support speech perception, does seem to accord with the results. The presence of a referent appears to help child Subjects in several ways. First, it makes the initial presentation of some word tokens, -- the only presentation in unrecorded speech --, easier for child listeners. Second, it makes for more profit from the same amount of practice: children showed more improvement over presentations when the second was in the Visible condition. With a little imagination, one might suggest a naturalistic analog to this effect. While parents will never produce two successive tokens of the same word with the same acoustic shape, they are certainly known to repeat words or utterances several times in quick succession when speaking to children (Cross, 1975, 1977). Although Bard, Anderson, and Laver (1982) have shown that the later tokens in such a series are no clearer *per se* than the first, the very existence of the series may give the child time to scan his environment and create for himself the Hid-->Vis condition. First utterances in such series may then turn on a visual search mechanism which enables some later rendition to be interpreted. Third, the visible presence of the named object appears to further the Child Addressee Advantage. To be more precise, the Nonmatched Words to children, when presented in the Visible condition, had the best recognition scores of all, while words not meant for children gave no sign of this effect. If we accept the argument made earlier (Chapter 3, Section VII) that the vocabularies of parentese and adultese are largely non-overlapping, then even without random sampling of words, the Nonmatched stimuli may well be the more representative of their populations. What the results then mean is that extra-linguistic context can help children in recognizing some of the words which are most likely to be said to them.

At this juncture it may be worthwhile to ask why visual context helps children and not adults. The simple answer is that adults are so good at the task here that no help is possible. Even their 'Hidden' performance is close to a ceiling level. The children's scores (about 40% correct) do leave room for improvement. But why should the adults have been so successful at this task (80% correct) when they performed at a much lower level (37% correct) in earlier experiments? Of course, they may have profitted from the fact that the object names in Experiment 7 should have been more intelligible than the many function words in Experiments 1 and 2 just on grounds of length and phonetic content. But the difference must also have something to do with the fact that in the earlier experiments, adults had to select a word's identity from the whole lexicon of conversational speech, while in the present case, the choice was limited to 25 known concrete nouns. If, however, the adults were able to make use of the restricted target set throughout Experiment 7, they must have carried the set, -- in the mind's brain, if not in the mind's eye -- , even when the objects were hidden from physical view. To anyone who can remember and mentally scan a complete target set, all conditions are essentially 'Referent Visible'. By implication, then, children may do poorly when the toys are physically hidden because they are unable to keep them mentally 'visible'. Given that young children are not particularly good at purposeful, strategic use of memory (Huttenlocher and Burke, 1980), this implication is a sensible one. One can then see at least one reason for their widely attested (see Donaldson, 1978; Wilcox and Palermo, 1975; Wilcox and Palermo, 1982) dependence on nonlinguistic context in their dealings with language: if they cannot remember, they do well to observe.

In summary, then, Experiment 7 closes one exit from the quandary posed by the findings of Experiments 1 and 2 and opens up others. Young children appear to be unable to use a propensity for bottom-up processing to break out of the Pollack and Pickett effect and the child addressee disadvantage which aggravates it. Nor do they have a special affinity for the way parents speak to children. Rather they seem to find the odd parental word token extraordinarily intelligible and to use their eyes to increase their chances at word recognition. But it is not at all obvious what makes that odd word token intelligible and its neighbor less so. Nor is it self-evident why some words can benefit more from the presence of denotanda than others.

Experiments 8 and 9 attempt to answer these questions.

IV. Experiment 8: Redundancy

IV.A. Background

The reader will recall that in Chapter 3, the redundancy of word tokens as measured by their predictability from their sentence contexts correlated negatively with the intelligibility of the token presented in isolation. Because words spoken to children were more redundant than words to an adult, the former were expected to be, and were, the less intelligible. In Experiment 7, on the other hand, we found that object names spoken to children were relatively easy to identify, but we lacked an explanation for that fact. Experiment 8 is designed to look for one in the redundancy-intelligibility relationship. Although the randomly sampled words to children were earlier found to be more redundant than those to adults, object names as spoken to children may be rather less redundant than that sample's average. If this is so, redundancy can once again be adduced in explanation of the Addressee effect.

The structure of Experiment 8 is somewhat complicated by the fact that redundancy is now expected to explain two different sets of results: the children's and the adults'. While there may be clear differences in the predictability of words in the critical cells of Experiment 7, the changes concomitant with predictability will be unable to explain the behavior of both groups of Subjects simultaneously.

IV.B. Method

IV.B.1. Materials and Design

The source sentences for all 96 conversational forms in Experiment 7 (See Appendix D.1) were divided into two groups of 48, each equally representing both addressees and each of the twelve speakers. A single random order was chosen for both groups so that where one had a speaker's sentence to the child, the other had its mate to the adult. The materials for each group consisted of the audiotaped and typed versions of 48 source sentences, each lacking the Experiment 7 stimulus word. The tapes were prepared by cross-recording the source tape loops without the contents of the window used in segmenting out the single word stimuli, and the typed stimulus list marked the position of the gap with a line of standard length.

IV.B.2. Subjects and Procedure

The 48 *S*s, all adult members of the Edinburgh University community were tested in groups of from three to twelve. Twenty-four *S*s heard each set of 48 sentences. They were asked to listen to the taped version of each sentence and then to restore to the typescript what they supposed was the deleted word. Each stimulus was announced by number and played three times.

IV.C. Results

IV.C.1. Scoring

Responses were scored correct if they matched the missing word exactly. One of the Matched Word pairs was eliminated from consideration because the source sentence for the same addressee had inadvertently been included in both groups of stimuli. Hence, scoring was based on 24 pairs of Nonmatched Words and 23 Matched.

IV. C. 2. Analysis

Table 4.5 gives the mean redundancy scores for Matched and Nonmatched Child and Adult words. Note that the least redundant cell, Nonmatched Child Words, corresponds to the most intelligible in Experiment 7.

The expected difference in favor of words to adults reaches significance only for both types of words taken together ($t=2.03$, $df=45$, $p<.025$, one-tailed), but not for either type alone (Matched Words: $t=1.07$, $df=22$, n.s.; Nonmatched Words: $t=.82$, $df=23$, n.s.).

Table 4.6 shows the correlations between redundancy scores and the intelligibility of the isolated word in its first presentation in Experiment 7. Plainly, there was no real relationship between adult Subjects' ability to recognize these stimuli and their redundancy. The only possible exception is the case of Nonmatched Words to children. Child Subjects did show the predicted negative correlation in general, but though the relationship was quite strong among words to adults, it was very nearly nonexistent among words addressed to children. It would seem, then, that the adults in Experiment 7 did not behave like those in Experiments 1 and 2 and that whatever adjustments parents make in response to the sentential redundancy of object names to children, children's word recognition is not directly sensitive to them.

However dissimilar these and the results of Experiment 4 may be, it is interesting that in both the highest correlations are found for Nonmatched Words. Chapter 3, Section VI.D, suggested that differences of delivery due to contextual redundancy were magnified by the differences in typical contexts for different lexical items. That explanation gains force from the replication here.

TABLE 4.5

Experiment 8. Mean numbers of Subjects Correctly Predicting Experiment 7 Stimuli from their Environments.

	Addressee	
Word Type	Child	Adult
Matched	5.35	7.43
Nonmatched	2.83	4.67
Overall	4.06	6.05

TABLE 4.6

Experiment 8. Correlations between Redundancy and Intelligibility for Child and Adult Subjects (Experiment 7).

Stimuli	Correlations with Child Scores		Correlations with Adult Scores	
	Pearson r	p	Pearson r	p
All	-.33	.001	.016	n.s.
Words to Adult	-.27	.05	.147	n.s.
Words to Child	-.048	n.s.	-.138	n.s.
Matched Words	-.108	n.s.	.129	n.s.
to Adult	-.171	n.s.	.23	n.s.
to Child	-.059	n.s.	.03	n.s.
Nonmatched Words	-.201	$<.10$	-.078	n.s.
to Adult	-.400	.05	.101	n.s.
to Child	.045	n.s.	-.28	n.s.

IV.D. Discussion

As an explanation for the results of Experiment 7, Experiment 8 is not very successful. True, it does find that, unlike the more general selection of words to children used in Experiments 1 and 2, the object names are less predictable than their counterparts spoken to adults. But this result explains little about Experiment 7, because the sizable negative correlation between redundancy and intelligibility has disappeared for adult Subjects and is not found for children listening to child-addressed words. Experiment 8 demands more explanations than it offers.

Several ideas developed in earlier discussions may be expanded to provide some of these. In fact, we have made observations relevant to both ends of the unsatisfactory correlation, the recognition scores in Experiment 7 and the contextual forces acting on the speaker.

In discussing Experiment 7 (Section III.D), we noted that the adults' scores were so consistently high as to leave little variance out of which to build effects of any kind. This same restriction in variance could equally well prevent the establishment of significant correlations between recognition scores and anything else, predictability rates included. Thus, Experiment 8 can be read not as casting doubt upon the intelligibility-redundancy correlation established in Experiment 4, but as reflecting the reduced variance of adults' scores in Experiment 7. In the same discussion, it was proposed that the relatively uniform accuracy of adults' performance was due to their ability to maintain a mental target list for all stimuli. If children have such a list available only in the Visible condition, they should show an adult-like pattern of responding in just this case. And they do: the Visible condition was most helpful for words spoken to children, and it is on these words as a group (see Table 4.6) that there was no significant correlation between redundancy and intelligibility for child listeners. For both classes of Subject, then, the limited set of referents, a condition not present in the design of earlier experiments, may have detracted from any true relationship between redundancy in sentence context and intelligibility in isolation.

A second approach deals with the forces controlling the precision with which the stimulus words were articulated. It proposes that various kinds of redundancy help to determine how clearly a word is enunciated. Lieberman (1963) chose to explore the effect of sentence-based redundancy on intelligibility because he wished to argue for the use of sentence-based syntax in speech perception, but the principle underlying his results is not necessarily so limited. If we pronounce a word less clearly because its environment might supply the perceiver with more information about its identity, then extra-sentential or extra-linguistic features which support word recognition may also affect word delivery. An examination of the present source sentences and their surrounding transcriptions indicates that such factors could be operating here.

For example, the stimuli originally spoken to children made reference to objects actually present at the time of speaking much more often (35 out of 47 cases) than did those to adults (14 out of 47). Bard, Anderson, and Laver (1982) have shown that concrete nouns used to refer to present objects, tokens which are in a sense more predictable from their extra-linguistic contexts, are less intelligible than tokens from the same speakers referring to absent objects. On these grounds, words to children tend to be the more predictable and should be the less intelligible.

Moreover, a larger proportion of the child-addressed sentences (20 as opposed to 6) contained no content word other than the stimulus and possibly the addressee's name or a pro-verb. This lexical poverty made for low intra-sentential predictability, but inspection of the surrounding transcriptions shows that these object names were used to refer to something that had already caught the addressee's attention, whether to locate an object in answer to a question, to offer advice about something the child was using, or to echo a child's utterance (see Appendix D.1). In these cases the structure of the discourse and the accompanying physical activities would predict object names to the listeners, and accordingly encourage the speaker to make them less intelligible.

When they produced the child-addressed stimuli, then, our informants were being induced to increase clarity by the words' low sentential predictability and to decrease it by their high redundancy in an extra-linguistic context. Given the two opposing tendencies and their interplay from word to word, it might be expected that measured predictability and intelligibility do not correlate in any robust way.

It is worth reconsidering other intelligibility-redundancy results in the light of these proposals. Since predictability from extra-sentential context is supposed to disrupt the original inverse relationship, that relationship should be convincing only when the other sources of redundancy are neutralized. We have already seen that most of the adult-addressed words from Experiment 7 were not used to refer to objects present at the time and did not appear in the sort of minimally lexicalized sentence that discusses a focus of the listener's attention. The articulation of these words would seldom be downgraded because their extra-sentential contexts predicted them. Accordingly, we find here a significant negative correlation between intra-sentence predictability and intelligibility to children. As for the significant correlations with adults' scores in Experiment 4, these were based on stimuli of varying form class, many of which were not susceptible to the other sorts of effects which we have been discussing. It is difficult to see how words like 'variety', 'with', and 'mean', for example, could be predicted from the objects in use as they are said. So far as this analysis extends, then, there is a good negative correlation between intelligibility and predictability from sentence context wherever other kinds of redundancy are minimal[7].

V. Experiment 9: Age of Acquisition

V.A. Background and Purpose

Though Experiment 8 attempted to explain some of the results of Experiment 7 in terms of the environments in which the chosen word tokens were produced, it is fairly clear that the particular lexical items involved played a role as well. The Child Addressee Advantage worked only where words to children and adults were different lexical items. Of course, it is always possible that particular lexical items have an affinity for certain levels of redundancy, but the marked differences among lexical items and the modest proportions of the variance covered by intra-sentential redundancy (Table 4.6) both argue that there is more to the picture than the effects of words' contexts. Some attempt to understand the lexical basis for intelligibility differences was clearly in order.

Chapter Five will deal with the relationship between the intelligibility of a stimulus word and its length and frequency of occurrence in the language, variables which have been shown to influence auditory word recognition (Rosenzweig and Postman, 1958). But another variable has been suggested more recently which may be more relevant to word recognition in young children than frequency alone and which requires a panel of adults to assess: age of acquisition.

Carroll and White (1973a and b) first showed that age of acquisition, as measured either by the subjective judgments of a panel of adults or from a survey of children's writing (the two correlate at +.85), predicted latency in a picture naming task better than did frequency according to the Thorndike-Lorge (1944) or Kučera and Francis (1967) norms. Adding frequency to a regression equation containing the age of acquisition variables offered no significant improvement in prediction. In fact, Carroll and White suggested, age of acquisition may be the 'active principle' in frequency effects: when the relationship between frequency and age of acquisition was partialled out of word frequency, its correlation with the latency measure dropped from +.674 to +.151. Later studies went on to show that age of acquisition was a good predictor of adults' certainty in naming pictures (Lachman, 1973; Winters, Winter, and Burger, 1978) and, more to the point here, of five-year-olds' ability to label pictures correctly (Winters *et al.*, 1978).

If the age at which an object name is acquired can predict an adult's tendency or indeed a child's ability to use the name correctly, it may have something to do with our child Subjects' skill at recognizing the word in question. Carroll and White point out that their results could be explained if words acquired early were more accessible in memory than words acquired late. Thus, our Subjects may have been readier to access the stimuli representing the earlier acquired lexical items. If the three-year-olds, familiarization notwithstanding, had imperfectly assimilated some of the 'later' items, age of acquisition could offer a useful predictor of word recognition.

Since age of acquisition estimates were not available for most of the words used in Experiment 7, the present experiment was run to collect them. Carroll and White's method of eliciting judgments was readily applied,but the exercise proved quite unhelpful.

V.B. Method

V.B.1. Materials and Procedure

A randomized list was prepared of the 48 Nonmatched Words from Experiment 7 plus those Matched Words which did not overlap with these. The same list was presented to all Subjects along with an accompanying sheet of instructions and an eight-point grading scale adapted from Carroll and White (1973a). Both are reproduced in Appendix E. Subjects were given the instruction and test sheets and were asked to write next to each word the code corresponding to the age when they believed they themselves had first learned the word. All Subjects filled out and returned the sheets at their leisure.

V.B.2. Subjects

The *S*s were 28 native speakers of English ranging in age from 18 to 65 and affiliated with Edinburgh University or attached research institutions.

V.C. Results and Discussion

All Subjects who received the materials completed and returned them. Their judgments were consistent (the standard deviation of judgments over all Subjects averaged 48% of the mean), and slightly conservative. The grand mean, 2.38, represents the opinion that the words were learned at some point between Carroll and White's Grade 2 (age three or four) and their Grade 3 (age four or five). In fact, none of our child Subjects, some of whom were not yet three, was obviously ignorant of more than one or two of the words.

As an explanation for the Addressee effect in Nonmatched Words, age of acquisition proved to be a failure. The mean acquisition grade for each of these words over all Subjects was prepared and the mean over all words to each addressee was computed from these. Words to adults had a mean of 2.34 (s.d.=.662), while words to children had a mean of 2.42 (s.d.=.807). Clearly, the difference was neither in the predicted direction nor large enough to be significant. Thus, whatever made some of these words good stimuli, it does not seem to be their locations in a chronologically arranged mental lexicon.

VI. General Discussion

This chapter began by attempting to confront the problem which earlier results posed for our view of young children's linguistic input. Not only was the Pollack and Pickett effect applicable to parental speech, it was more applicable than to speech among adults. At least these had been the findings for adult listeners. The work described in this chapter was to find some ability in children to overcome such processing difficulties as might be posed by the apparently poor quality of speech addressed to them.

Within our comparison of parentese and adultese this goal was only partially achieved. Consistently in both pilot Experiment 6 and Experiment 7, child listeners found that tokens of concrete nouns from parents' speech to their children were harder to recognize than tokens of the same words produced for adults. Equally consistently, the pilot Experiment 5 and Experiment 7 found that when different lexical items were chosen from speech to the two addressees those for children were the more intelligible. Thus parentese delivery, which we know is the less clear to adult listeners, is often less clear to children as well. Only the fact that some lexical items spoken to children are especially clear help might children to perceive speech when its linguistic structure is beyond them.

As for the utility of extra-linguistic context in these situations, the case is also somewhat less compelling than we might wish. Experiment 7 showed that children can indeed improve their recognition scores somewhat above the level achieved by adults in Experiments 1 and 2 (42% vs 37%) when the set of toys named by the stimuli are among those visible at the time. Since this effect was restricted to the stimuli originally addressed to children and since the presence of referents also helped in boosting scores between presentations of the same stimuli, we argued that the domain in which extra-linguistic context operated matched certain natural conditions for children's speech perception. But even this positive finding must be viewed with caution. The effect of extra-linguistic context was not significant in any analyses covering both presentations of the stimuli, nor was it ever significant by materials. Once again we have an aid to children's speech perception which only works sometimes.

The helpful instances affect both the Context and the Addressee effects, as each was significant only when the other was. Yet two attempts to find a way of predicting the intelligible word tokens proved relatively unprofitable. Experiment 8 assessed the predictability of Experiment 7's stimuli from their sentence contexts. While the least predictable words were the Nonmatched Words to children, which had been the most intelligible set, the correlations between redundancy and recognition score were by no means as orderly as they had been for the material examined in Experiment 4. Probably because they were so consistently good at the recognition task, adult Subjects showed no significant intelligibility-redundancy correlations. Child Subjects did find the more predictable items the less intelligible -- except among the set in which we were the most interested, the Nonmatched Words to children. Here many words referred to objects which were quite predictable from their extra--sentential contexts either simply because they were present at the time of mention or because the listener's attention was already focussed on them. It was proposed that the additional redundancy from these sources might outweigh or be integrated with predictability from sentence context in determining the parent's articulatory precision. Consequently, the method of Experiment 8 was unlikely to predict the crucial intelligible items. Experiment 9 turned to a characteristic of the lexical items rather than of their tokens and elicited age of acquisition judgments for the same stimuli. This approach was even less helpful than the other, for the Nonmatched Words to children and adults had roughly equal ages of acquisition. In short, nothing we have seen so far could enable us to explain which words will be easy for children to recognize.

An explanation is worth searching for. It is important to remember that the child listeners were simply not very proficient at the task of recognizing forms taken from running speech. At roughly 39% correct, they were very signficantly worse than they were for tokens of the same words as read in a list (72-79%). And although their performance improved under the conditions discussed above, the most intelligible set of conversational forms in Experiment 7 scored only about 55% correct. If our word samples are representative, then, all the aids to perception uncovered here would succeed in allowing the child to recognize slightly more than half of the object names addressed to him in the presence of their referents. It would be expected that the child will do worse on words of classes for which the physical environment is less disambiguating. Because the child has such modest success at recognizing words from their acoustic shapes, we should suppose that those occasional tokens which are extraordinarily intelligible will be the linchpins both for earliest language learning and for any higher order processing that the child is later able to bring to bear. Given the probable importance of such words, Chapter Five tries to do statistically what this chapter was unable to accomplish by means of experiments: to provide some description of what makes a word token intelligible to a young child.

Footnotes

1. Mean length of utterance estimates for three-year-olds are approximately 4.20 (DeVilliers and DeVilliers, 1972, 1973).

2. More correctly, all stimuli were either object names or their homophones, as Appendix D.1 shows.

3. While torturous, this design had the advantage of measuring the Context Effect within Subjects and within words, a strategy which seemed advisable in view of the large inter-Subject and inter-word variance expected here. Repeated presentation of the same stimuli and the resulting counterbalancing with Order of Presentation were the price to be paid.

4. The delay for the second session was the only real cause of Subject attrition. No subjects were eliminated because they could not perform the task. The prevalence of minor infectious diseases among nursery children, however, meant that a number of children run on the first session were simply not at school on any days when they might have been run on the second. Their data were discarded and they were replaced by new Subjects.

5. This strategy clearly has the disadvantage of yielding ANOVAs with only about half the degrees of freedom laboriously amassed by testing 64 three-year-olds, of disregarding some of their data, and of failing to produce a true estimate of inter-Subject variation. The result was by no means disastrous. For purposes of comparison, the same data were analyzed in a series of ANOVAs with no repeated measures. As these used unpartitioned error terms with the maximum available degrees of freedom and produced roughly the same significant effects as the analyses by replicates, little was lost in the more conservative treatment. Analyses of the children's first presentation data including conditions not filled in the adult design also produce similar results: see Appendix D.5).

6. This conclusion is not precisely what the composite analysis shows, because the analysis actually has different word tokens in the Hidden and Visible conditions. But it is true. The separate ANOVAs on children's first presentation results (Appendix D.5) contain scores for the same word tokens in the two Context conditions and also show that the Child Advantage for Non-matched words is larger in the Visible condition. This interaction (Context x Addressee) does not approach significance.

7. The words in Lieberman (1963), of course, came from sentences read in an unstructured list and so had no relevant extra-sentential context. If

sentential context is ever to control articulation, it should do so here.

CHAPTER FIVE: Stimulus Variables

I. Introduction: Unfinished Business

The results of the experiments reported in the last two chapters leave much to explain. The change in the Addressee effect from a Child Disadvantage in Experiments 1 and 2 to a Child Advantage in Experiment 7 certainly requires comment. The failure of child Subjects to show the consistent Addressee effects exhibited by their adult controls is also not fully accounted for and the shift from robust by-materials effects in Experiment 1 to their near-total absence in later experiments draws our attention to characteristics of the individual stimuli. These may vary sufficiently to outbalance clear by-Subject trends, and yet we have a very incomplete idea of what the relevant stimulus differences might be. If we were to discover the features which make stimuli intelligible to child and adult listeners, we would be in a better position to explain the experimental findings and to confront the larger issues of the nature of the young child's word recognition.

Such ideas as we have developed about the revelant stimulus features depend largely on the notion of redundancy, here defined as the predictability of a word from its immediate sentence context. Experiment 4 demonstrated that the intelligibility of a sample of isolated word stimuli was negatively correlated with their predictability. As words to children proved more predictable than words to adults, this negative relationship was proposed to account for the Child Addressee Disadvantage.

Yet this notion requires elaboration. For one thing, the predictability x intelligibility correlation (-.30) accounts for no more than 9% of the variance in intelligibility. Something else must be involved. Further, predictability and intelligibility were more strongly associated for Random Words, where the tokens to the two addressees represented different word types, than for Matched Words, which were composed of pairs of tokens of the same lexical items. It was suggested (see Chapter III, Section VI.D) that the range of predictability values associated with any given word type ('type' for example) might be more limited than the range available to two different words ('elephant' vs 'cat') especially when, as in our example, they also differ in length and frequency of occurrence. Length and frequency of occurrence are themselves associated with intelligibility differences, at least for citation forms of words (Rosenzweig and Postman, 1958). Hence this account nominates three cooperating, though imperfectly intercorrelated variables -- redundancy, length, and frequency -- from which intelligibility might be predicted.

Our attempts to explain Experiment 7 results via predictability from context (Experiment 8) brought the notion of redundancy into further difficulty. Adult-addressed object names now tended to be more readily predicted than their child-addressed counterparts, and the negative correlation between redundancy in context and intelligibility in isolation was not generally reproduced. It was suggested (Chapter 4, Section IV.D) that 'true redundancy' for object names might be a more complex measure than for stimuli covering other word classes. An object name may be predicted from the presence of its denotandum as well as from its linguistic surroundings, while some other form classes might have a less direct link to their extralinguistic context. Thus another variable, the physical presence of the named object, might operate jointly with sentential redundancy to affect intelligibility and disrupt the simple correlations which we found earlier.

In this chapter we will attempt to further the explanation of crucial effects by examining these and other stimulus variables simultaneously in correlations and in multiple linear regression equations. Section II describes the variables used, their measurement, and the statistical methods employed to determine their inter-association and their relation to the experimental results. Sections III and IV outline the results of these procedures, and Section V discusses the implications of the study.

II. Method

II.A. Independent Variables

Table 5.1 contains a list of the independent variables examined and the Experiments to which they apply. The variables were conceived of as belonging to four groups: those pertaining to the parameters of the original Corpus design, essentially descriptions of speaker and addressee (Corpus Variables); those describing the stimulus as a lexical item (Type); those recording characteristics of the stimulus as a piece of behavior (Token); and the one variable imposed as a treatment (Experimental). Each is described below.

II.A.1. Corpus Variables

Parent Sex (PSEX), Addressee (ADD), Child Age (CAGE), Child Sex (CSEX). These are simply descriptions of the speaker and hearer of each stimulus when it was uttered in a corpus interview. All but Child Age were coded as dummy variables with the values 0 and 1 assigned as listed in Table 5.1. Each of the three levels of Child Age was translated into the median age in months for its interval (23, 29, 35).

II.A.2. Type Variables

TABLE 5.1

Independent Variables Used in Multiple Regression Analyses for Experiments 1, 2, and 7

Set	Variable	Abbrev.	Experiments	
			Expt 1 & 2	Expt 7
I. Corpus	.Parent Sex (1=father, 0=mother)	PSEX	+	+
	.Addressee (1=Child, 0=Adult	ADD	+	+
	.Child Age (23=i, 29=ii, 35=iii)	CAGE	+	
	.Child Sex (1=Male, 0=Female)	CSEX	+	+
II. Type	.Kucera and Francis Frequency	KF	+	+
	.Form Class (1=Contentive, 0= Functor)	FORM	+	
	.Object Name (1=Object Name 0=Other Words)	ONAME	+	
	.Age of Acquisition	AGE		+
	.Number of Syllables	SYLL	+	+
III. Token	.Length in Msec	LENGTH	+	+
	.Rate in Msec/Syll	RATE	+	+
	.Redundancy	RED	+*	+
	.Context of Speaking (1=Present, 0= Absent)	CSPK		+
	.Context of Content Words (1=Sole Contentive, 0=Others)	CC		+
IV. Experimental	.Context of Presentation	CPRS		+

* Redundancy measures were available for all Matched Words but for only 48 Random Words.

Kučera and Francis Frequency (KF). For each lexical item the frequency of occurrence in the sample of Kučera and Francis (1967) was recorded.

Form Class (FORM). Another binary variable, this marked stimuli as being Content Words (also called 'semantic' or 'lexical words') and Functors ('grammatical words'). Functors tend to be more frequent and shorter than the content words, and in some cases, at least, (Brown and Fraser, 1963; Nelson, 1973) may be acquired later or may be less perceptually salient for children (Scholes, 1970). It remained to be seen whether the gross division bears any relationship to intelligibility.

Object Name (ONAME). In Experiments 1 and 2, this variable subdivided stimuli into Object Names and other words in an attempt to compare the former with the set of object names used as stimuli in Experiment 7.

Age of Acquisition (AGE). This variable was derived from the means of estimates supplied by subjects in Experiment 9. Since there was no difference in the mean Age of Acquisition by Addressee for Experiment 7 materials, an association between a word's estimated acquisition age and its intelligibility might help to damp the by-materials Addressee Effects.

Number of Syllables (SYLL): This is the first of a set of measures used to assess the length of the stimuli. The duration of any word token should depend both on the amount of phonetic material in the word type of which it is an instance and on the speed and precision with which it is delivered. It might be thought that some phonetic transcription or phonetic spelling of a stimulus word would provide a better account of the type's true length, but the choice of transcription is not simple. It is not obvious how phonetic the transcription should be, whether it should conform to the informant's idiolect, or whether it should reproduce as nearly as possible a citation form of the word, a version read from a transcription of the source sentence or, most difficult of all, the stimulus itself. It is possible to avoid these issues altogether, by using the syllable measure adopted by Rubenstein, Decker, and Pollack (1959). The number of syllables to be attributed to a lexical item is nearly always unambiguous, and where it fails in sensitivity, the measure can be supplemented, quite effectively, as we shall see, by the Token variables Rate and Length in Milliseconds.

II.A.3. Token Variables

Length in Milliseconds. (LENGTH). For each stimulus word the length in milliseconds was determined from the recorded length of the segmenter window used to secure the stimulus. Length can be seen as both a Type and a Token variable, the former because it is sensitive to the amount of phonetic material in a word form, and the latter because it must depend on speech rate. The intelligibility of a word might be related to either aspect of this measure, material length, or length as a function of delivery. As we shall see, it will be possible to separate these.

Rate in Msec/Syll (RATE). This measure is derived as its name implies by dividing the duration of each stimulus by its number of syllables. It is included both to supplement the two duration measures described above and to test one of the parameters of tonic stress. Garnica (1977) has pointed out that texts read to young children contain more stressed syllables than those read to adults. Insofar as stressed syllables occur, there may be a tendency for slow speech to children (but see the discussion in Chapter Two, Section IV). The rate measure, which is relatively free of the type-based aspects of duration, may help to test Garnica's prediction on a sample of spontaneous speech.

Redundancy (RED). This measure comes from the number of subjects in Experiment 4 or 8 who could correctly supply a stimulus word given its context sentence.

Context at Time of Speaking (CSPK). A binary measure, CSPK marks each Experiment 7 stimulus for the presence or absence of the object to which the speaker was referring. Assignments were readily determined given the full transcriptions of interviews and a list of objects present in the interviewing studio.

Context of Content Words (CC). This binary variable divided stimuli for Experiment 7 into a group which had been the sole content words in their source sentences and those which had not. It had been suggested (Chapter 4, Section IV.D) that this distinction was related to CSPK, in that only objects which were both physically present and the center of speaker's and hearer's attention were likely to be named by the unique content word in a sentence. It is also not unreasonable to suppose that if tonic stress tends to be found on the last content word in a sentence, the sole content word is likelier than most other stimuli to carry tonic stress. Whatever intelligibility advantage accrues to a tonic should boost the recognition scores of the words scoring 1 for CC[1].

II.A.4. An Experimental Variable:

In Experiment 7 a further variable is added, *Context of Presentation (CPRS)*, for some stimuli were presented with the named toys visible and some with the toys hidden.

II.B. Statistical Methods

II.B.1. General Procedure

Analogous multiple linear regression and correlation measures, all calculated via BMDP-P1R (Dickson and Brown, 1979), were found for three different dependent variables, the adults' scores in Experiment 1 and 2 and in 7, and the children's scores in the treatment conditions of Experiment 7 which the adults experienced. In each case, the investigation followed the general strategy described here.

The first task was to establish which independent variables contributed appreciably to the prediction of intelligibility scores. To obtain the best available estimates here, all the stimuli for which the dependent variable was measured were analyzed together. The independent variables were explored in a set-hierarchical fashion (Cohen and Cohen, 1975) which Section II.B.2 will describe in some detail. Each stimulus set was then subdivided, once by Addressee and once by Stimulus Type (Nonmatched/Random vs. Matched), and the resulting regressions compared.

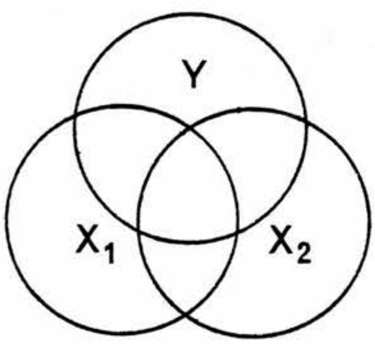
Next the relations among certain structural subsets of independent variables were explored. Duration variables (LENGTH, RATE, SYLL), contextual variables (RED, CSPK, CC), the two sets together, and familiarity measures (KF, AGE) were examined here. The method, as detailed by Cohen and Cohen (1975), requires multiple regression equations to be derived using various combinations of variables within a predictor group in question. The variables' cooperative contributions to intelligibility are deduced from the differences between their standardized regression coefficients alone and in combination. As Cohen and Cohen illustrate succinctly, if the absolute value of the standardized regression coefficient (β_i) of an independent variable (X_i) decreases when a second variable (X_j) is added to the equation, the two are redundant in predicting Y (Figure 5.1.a). In situations of extreme redundancy (multicollinearity), two variables will so overlap that neither makes any contribution to the dependent variable without the other. In a multiple regression, the two, like the gingham dog and the calico cat, will eat each other up. If on the other hand, β_i moves further from 0 without changing sign when X_j is added to the equation, the relation is one of suppression: X_j accounts for part of the variance in X_i which is not related to the dependent variable, and when this variance is partialled out on X_j's entry, β_i represents the relationship between X_i and Y as a proportion of the (newly reduced) undescribed variance. In such instances, X_j, the new independent variable, may be uncorrelated with Y itself (Figure 5.1.b) or may contribute relatively little to predicting Y (Figure 5.1.c). And finally, both β_i and β_j may move away from zero in the new equation. This change is diagnostic for 'cooperative suppression': the suppression by each variable of some part of the other's variance which is unrelated to Y (Figure 5.1.d).

Finally the implications of these analyses were brought to bear on the experiment's Addressee effect. First, the correlation of Addressee with each of the other independent variables was obtained. From these, the significant differences between parentese and adultese could be determined: the t associated with a correlation including a dichotomous variable is identical to the t for the difference between the mean values of the other variable in the two groups. For example, if the r for Addressee and Redundancy is significant, the mean redundancy scores of words to child and adult will differ significantly. Any variable which showed a significant Addressee effect and which contributed sizably to the prediction of intelligibility was a candidate source for the differences in intelligibility by addressee.

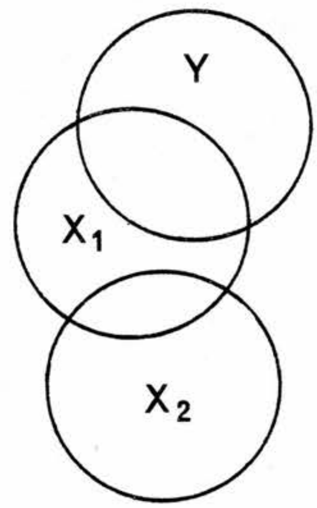
II.B.2. The Set-Hierarchical Approach

FIGURE 5.1

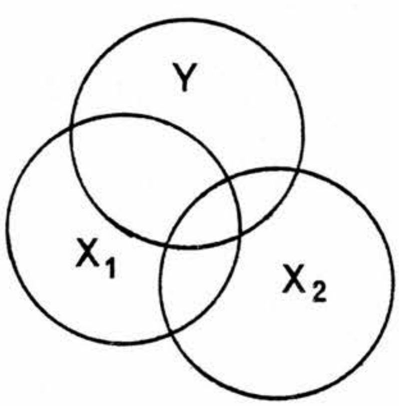
Diagrammatic Representation of Certain Relationships among Independent and Dependent Variables.



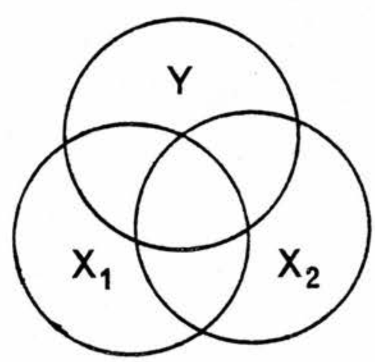
a. Redundancy
$(r_{12} > 0)$



b. Classical Suppression
$(r_{Y2} = 0)$



c. Net Suppression



d. Cooperative Suppression
$(r_{12} < 0)$

The method described here is modified from Cohen and Cohen (1975, Chapter 4), where it is presented as a commonsense approach to multiple regression with large numbers of independent variables, and as a modest statistical safeguard against Type 1 error.

The first step is to subdivide independent variables into sets which may be supposed on theoretical grounds to apply in a fixed order. In the present analyses, the sets and the order implied by Table 5.1 were used. The Corpus variables originating in the interlocutors seemed to be logically prior to the Type variables which derived from the choice of a lexical item to be used in their conversation. Third came the variables associated with the occurrence of the sampled token of that lexical item. Finally, the influence of an experimentally induced context (CPRS) might impinge on recognition scores.

At least two sorts of complaints might readily be made against this ordering. The first is that some of the Token variables could operate on the speaker before he chooses a lexical item. The presence of the item to be named might influence what it is called, as quite reduced referring expressions might be perfectly effective when a listener can see the object they name. Then too, the structure of the context sentence before the stimulus word might help to determine what lexical item will then be chosen. Since Lieberman (1963) found that 'left-contexts' (that part of a sentence preceding a word), make the same sort of predictions as 'total contexts' for intelligibility, our measure RED ought perhaps to enter the equation before SYLL or KF.

The second objection observes that by entering RATE and LENGTH in the same step, we will lose the opportunity to discover the contribution made by simple temporal duration or the role of speed of delivery and find only the predictive power of duration with speech rate partialled out and of rate regardless of word length.

While these points certainly have weight they are not crucial for the sort of exploratory exercise involved here. Ordering all variables individually would entail a theory of speech production so detailed as to be beyond the bounds of the present study. Moreover, the major predictors of intelligibility in these data usually stand out whatever their order of entry, as we shall see from our closer look at structural variable sets. There, too, we will have the opportunity to separate LENGTH from LENGTH- with-RATE-controlled-for.

Once the hierarchical sets and their order are determined, the sets are added cumulatively to the equation and the gain in proportion of variance accounted for (multiple R^2) is assessed by an F-test which compares this gain with the current estimate of error variance (Model I, Cohen and Cohen, p.135). Should the gain be significant, individual variables in the set are examined by t-test to determine which contribute significantly to this increase. Even if the gain is not significant, the set's variables are left in the equation, since one or more of them might rise to significance when further variables are added.

An approach of this sort is plainly descriptive rather than predictive. The size of the unstandardized regression coefficients (B-values) is not really at issue here and probably should be ignored in a *post hoc* analysis of the sort to be presented in this chapter. Without sampling from the full range of values for each independent variable, we should probably not attempt to predict, for example, how many tenths of a listener will recognize a stimulus for each millisecond of its duration. The set-hierarchical approach will serve a more limited purpose of screening a large group of plausible independent variables for those which do relate to intelligibility.

III. Experiments 1 and 2

III.A. Set-hierarchical Analysis

III.A.1. Overall Analysis

Table 5.2 contains the β, R^2, and F values for two hierarchical analyses of Experiment 1 and 2 materials, one on the full set of materials (288 words), the other on the 48 Random and 48 Matched words for which Redundancy scores were available. A perusal of the table will show that the two analyses yield essentially the same picture.

In both cases the first set to be entered, the Corpus variables, account for a significant proportion of the variance in recognition scores (about 9%, $F=7.05$, $df=4.283$, $p=.00002$ for the full set; $F=2.476$, $df=4,91$, $p=.049$ for the subset). In both cases ADD and PSEX make significant individual contributions to this coverage, as we might have expected given the results of ANOVAs including these variables (see Chapter 3, Section III.C.3): words to adults and words spoken by mothers are clearer.

For both analyses, the addition of Word Type variables significantly increases the proportion of variance accounted for ($\delta R^2=.1257$ for the full set, $F=11.187$, $df=4,279$, $p<.001$; $\delta R^2=0.2145$ for the [illegible] subset; $F=6.788$, $df=4,87$, $p<.005$) and the variable responsible is the length of the word in syllables. At this point, the contribution of ADD to the subset equation ceases to be significant. The inference to be drawn is that part of the Addressee effect in these words is carried by Word Type variables. As SYLL is both the significant member of this set and its only component with a non-negligible β-value, it must be the positive relationship between syllable length and intelligibility which has disposed of an independent effect of addressee. We would predict that some words to children are less intelligible because they contain

TABLE 5.2

Experiments 1 and 2: Set-Hierarchical Multiple Regression Analyses for All Words and for the Subset Measured for Redundancy.

Variable Set	I.V.	Materials All (N = 288) β (p)	F	R^2	∂R^2
Corpus	ADD	-.242(.001)	7.050	.0906	.0906
	CAGE	.039	(4,283)		
	CSEX	-.105	p=.00002		
	PSEX	-.141(.013)			
+ Type	ADD	-.165(.003)	9.625	.2163	.1257
	CAGE	.035	(8,279)		F=11.187
	CSEX	-.087	$p < .00001$		(4,279)
	PSEX	-.151(.005)			$p < .001$
	SYLL	.323(.001)			
	KF	-.038			
	FORM	.082			
	ONAME	.047			
+ Token	ADD	-.146(.004)	15.013	.3515	.1352
	CAGE	-.031	(10,277)		F=28.875
	CSEX	-.100(.041)	$p < .00001$		(2,277)
	PSEX	-.100(.045)			$p < .001$
	SYLL	-.054			
	KF	-.003			
	FORM	.012			
	ONAME	.006			
	RATE	-.295(.030)			
	LENGTH	.689(.001)			

TABLE 5.2 (cont'd)

Variable Set	I.V.	Materials			
		Subset (N = 96)			
		β (p)	F	R^2	δR^2
Corpus	ADD	-.215(.003)	2.476	.0982	.0982
	CAGE	.014	(4,91)		
	CSEX	-.020	p=.049		
	PSEX	-.227(.025)			
+ Type	ADD	-.109	4.948	.3217	.2145
	CAGE	.047	(8,87)		F=6.788
	CSEX	-.041	p=.00005		(4,87)
	PSEX	-.217(.019)			p<.005
	SYLL	.404(.001)			
	KF	-.064			
	FORM	.061			
	ONAME	.146			
+ Token	ADD	-.094	5.338	.4114	.0987
	CAGE	.056	(11,84)		F=4.695
	CSEX	-.026	p<.00001		(3,84)
	PSEX	-.153			p<005
	SYLL	-.146			
	KF	-.008			
	FORM	.060			
	ONAME	.097			
	RATE	-.581(.022)			
	LENGTH	.719(.002)			
	RED	-.129			

fewer syllables than words to adults.

Again both analyses show significant gain in R^2 with the addition of Word Token variables (δR^2=.1352 for the full set, F=28.875, df=2,277, p<.001; δR^2=.0987 for the subset, F=4.695, df=3,84, p=.005). In each case RATE and especially LENGTH contribute to a significant degree. At the same speech rate, temporally longer words are better recognized. And at the same word duration, words spoken faster are better recognized. Of course, what would make a stimulus longer under a fixed speech rate or faster under a fixed length in milliseconds must be the amount of material to be uttered. So the operative Token variable appears to be one which we did not measure directly, the amount of acoustic material in a word.

The third equation is particularly interesting because it implies certain interrelations among independent variables. While most of these will be treated in detail later, they deserve to be mentioned here. For instance, in the subset, the β for PSEX is no longer significant when Word Token variables are added. For these words, part of the PSEX effect may therefore be due to differences in the rate or length of mothers' and fathers' stimuli. On the other hand, the contributions of ADD and PSEX are still substantial in the superset equations, and the role of CSEX now reaches significance. Freely interpreted, these results imply that words spoken to adults, by mothers, and by the parents of girls were clearer for reasons that go beyond their rate or length.

There is also the strange case of Redundancy. Its simple regression coefficient for intelligibility was -.303 (p<.005) but within this equation, it is an insignificant -.129. Part of the influence we attributed to redundancy must have been exercised through other variables in list, because its contribution has proved so redundant to theirs. Which variables are involved we shall see below. It is also of note that SYLL, which was a significant predictor of intelligibility scores when only Corpus and Token variables were included, has also been supplanted. When RATE and LENGTH are added, they appear to assume the role of representing word duration. How the three variables are related we shall also see below (Section II.B).

Meanwhile let us summarize the set-hierarchical analysis for these experiments. First, each set of variables significantly contributed to an account of the variance in intelligibility scores, with the full set accounting for 35% of the by-materials variance. Second, the regressions for all 288 words and for a 48 word subset pointed in general to the same significant independent variables: ADD, PSEX, and SYLL or RATE and LENGTH. Finally, because of the changes at each stage, these regressions implied that some of the effects associated with ADD or RED might have been mediated by their relationships with other variables.

III.A.2. Effects of Grouping

To be sure that the overall regressions painted a realistic picture of all critical parts of the data, Grouped Multiple Regressions were run on the 288 words by BMDP-P1R. This program performs a multiple regression for the data taken as a whole, and for each of two groups. Finally, it estimates the difference between the two groups' regression equations via an F-test which assesses the reduction in error variance due to grouping.

When Experiment 1 and 2 data were grouped by Addressee, there was no significant difference in the regression equations ($F=1.413$, $df=11.266$, n.s.). Thus the intelligibility of speech to children and to adults bear roughly the same relationship to the independent variables measured here.

TABLE 5.3

Experiments 1 and 2: Set-Hierarchical Multiple Regression Analyses for Matched and Random Words Taken Separately.

Variable Set	I.V.	Materials: Matched Words (N = 48)			
		β (p)	F	R^2	∂R^2
Corpus	ADD	-.098	2.226	.1716	.1716
	CAGE	.018	(4,43)		
	CSEX	.069	p=.08		
	PSEX	-.396(.007)			
+ Type	ADD	-.098	3.914	.4065	.2349
	CAGE	.024	(7,40)		F=5.277
	CSEX	.178	p=.002		(3,40)
	PSEX	-.256			p<.005
	SYLL	.393(.012)			
	KF	.184			
	FORM	—			
	ONAME	.245			
+ Token	ADD	-.065	3.641	.4631	.0566
	CAGE	.019	(9,38)		
	CSEX	.176	p=.002		n.s.
	PSEX	-.177			
	SYLL	-.106			
	KF	.173			
	FORM	—			
	ONAME	.186			
	RATE	-.624			
	LENGTH	.692(.054)			

/continued

TABLE 5.3 (cont'd)

Variable Set	I.V.	Materials: Random Words (N = 240) β (p)	F	R^2	ΔR^2
Corpus	ADD	-.271(.001)	6.743	.1030	.1030
	CAGE	.043	(4,235)		
	CSEX	-.140(.024)	p=.00004		
	PSEX	-.091			
+ Type	ADD	-.173(.005)	7.938	.2156	.1126
	CAGE	.040	(8,231)		F=8.290
	CSEX	-.131(.026)	$p<.00001$		(4,231)
	PSEX	-.124(.037)			$p<.005$
	SYLL	.312(.001)			
	KF	-.045			
	FORM	.089			
	ONAME	-.041			
+ Token	ADD	-.146(.009)	13.968	.3789	.1633
	CAGE	-.031	(10,229)		F=7.526
	CSEX	-.128(.016)	$p<.00001$		(2,229)
	PSEX	-.064			p .005
	SYLL	-.008			
	KF	.004			
	FORM	.003			
	ONAME	-.068			
	RATE	-.185			
	LENGTH	.646(.001)			

The equations for Random and Matched Words do differ, however. Table 5.3 compares these full equations as well as those which would have preceded them in a set-hierarchical analysis. The pattern produced by the Random Words is essentially the same as the analysis in Table 5.2 of the superset in which those same Random Words predominate, but now RATE is not significant. For Matched Words, however, ADD is never independently significant and the addition of Token variables profits us little (δR^2=.0566, F=1.91, df=2,38, n.s.). As in Random Words, RATE is no longer a significant predictor of intelligibility and LENGTH is only marginally significant (p=.054). Thus the only variables which can differ across Addressee in Experiment 2 (ADD, LENGTH, RATE) fail to account substantially for the results. The reason for this loss of significance must have something to do with the very small N in this experiment, for the β values for Rate and LENGTH are quite high.

III.B. Relationships among Independent Variables

The hierarchical analyses leave us with problems to solve. If SYLL and LENGTH both measure a word's duration, why does SYLL cease to correlate with intelligibility when LENGTH is added to the equation? If RED was a substantial predictor of intelligibility by itself, what has subsumed its role in the multiple regression equation?

Table 5.4 shows the β values for LENGTH, RATE, SYLL, and RED alone and in combination.

In the simple regressions, LENGTH (Equation 1), SYLL (2), or RED (3) each have considerable value as a sole predictor of intelligibility. The rate of speech, with a β of -.036, on the other hand, has very little to do with successful word recognition[2]. To understand better what the Subjects were responding to, we must examine the change in R^2 and β values when these variables

TABLE 5.4

Experiments 1 and 2 (48 Random and 48 Matched Words): Relationships among Length, Rate, Redundancy and Number of Syllables.

Without Redundancy				With Redundancy			
i.v.	β	t	R^2	i.v.	β	t	R^2
				8.RED	-.303	-3.086***	.0920
1.LENGTH	.471	5.178****	.2219	9.LENGTH	.420	4.110****	.2316
				RED	-.110	n.s.	
2.SYLL	.478	5.282****	.2289	10.SYLL	.432	4.724****	.2688
				RED	-.205	-2.253*	
3.RATE	-.036	n.s.	.0013	11.RATE	-.134	n.s.	.1084
				RED	-.342	-3.343****	
4.LENGTH	.335	3.614****	.3239	12.LENGTH	.296	2.904***	.3302
SYLL	.347	3.744****		SYLL	.342	3.681****	
				RED	-.090	n.s.	
5.LENGTH	.729	7.212****	.3595	13.LENGTH	.674	6.211****	.3718
RATE	-.452	-4.468****		RATE	-.456	-4.532****	
				RED	-.125	n.s.	
6.SYLL	.580	5.843****	.2694	14.SYLL	.517	4.758****	.2845
RATE	.225	2.272**		RATE	.157	n.s.	
				RED	-.141	n.s.	
7.LENGTH	.789	3.611****	.3601	15.LENGTH	.785	3.612****	.3742
SYLL	-.062	n.s.		SYLL	-.120	n.s.	
RATE	-.514	-2.284*		RATE	-.577	-2.528**	
				RED	-.136	n.s.	

* $p < .05$

** $p < .025$

*** $p < .005$

**** $p < .001$

are combined.

Consider the results of pairing the duration variables. When LENGTH and SYLL appear in the same regression (4), the R^2 is significantly greater than that for either alone (F=10.598, df=1,93, p<.005 for the gain on LENGTH alone; F=9.871, df=1,93, p<.005 for SYLL), although each variable has a smaller β than it did independently. These two facts indicate that although LENGTH and SYLL are partially redundant measures of duration, the behavior of the Subjects in Experiments 1 and 2 was better accounted for by LENGTH and SYLL than by either alone. When LENGTH and RATE (5) are combined, we also achieve significant increases in R^2 (F=14.696, df=1,93, p<.005 over LENGTH; F=38.257, df=1,98, p<.001 over RATE) but now both β values move away from zero. Since the β for RATE alone was nearly zero, the change is diagnostic for classical suppression (see Figure 5.1.b). Only because LENGTH accounts for so much of RATE's variance does the relationship of the remainder to intelligibility look sizable. Furthermore, adding SYLL to the equation (7) provides no significant increase in R^2. The relationship of real importance here is the one that holds between Length in Milliseconds and intelligibility, one which is particularly strong for that part of LENGTH uncontrolled by speech rate. And this remaining part of LENGTH, as we suggested earlier, must surely be based on the amount of phonetic material in the stimulus.

Now let us turn to the role of predictability from sentence context. A perusal of the right half of Table 5.4 reveals that RED makes a significant independent contribution only in equations lacking LENGTH (10, 11). Whenever LENGTH does appear with RED in a regression equation (9, 12, 13, 15), the β-value for the latter moves toward zero (compare 12 with 10 and 8, for example). This pattern implies that LENGTH and RED are a redundant pair.

In fact RED has substantial negative correlations with LENGTH ($r=-.4588$, $df=94$, $p<.001$) as well as with LENGTH-partialling-out-RATE ($r=-.3750$, $df=94$, $p<.001$)

The reader may recall that this relationship was predicted in Chapter 3 (Section VI.D) when the simple correlation between redundancy and intelligibility was found to be stronger for Random than for Matched Words. At that time, however, we proposed only an association between word length and predictability from sentence context. What we find is that the association is crucial: although RED is a substantial single predicter of intelligibility (8), and a measure operationally distinct from word or token length, it actually works *through* the length measures.

III.C. Correlations with Addressee.

Table 5.5 lists all the independent variables displaying a significant correlation with ADD. The interpretation of the correlations is fairly obvious. Words sampled from speech to children were shorter in syllables and in millisecond length than those to the adult. They were more redundant, as we knew (Chapter 3, Section VI.C), and overall they tended to be object names more often.

Of these variables it is LENGTH which is most closely associated with intelligibility and therefore the variable most likely to mediate the Addressee effects of Experiments 1 and 2. But we must recall that since (Table 5.2) ADD retains a significant β in an equation containing LENGTH, there is more to the Addressee effect than meets the correlation matrices. Thus, while our informants produced less intelligible tokens for their children because they used shorter words to them, the tokens were less clear for other reasons too[3].

TABLE 5.5

Experiments 1 and 2: Variables Having Significant Correlations with Addressee.

Materials	All		Subset		Random (subset)		Matched	
VARIABLE	r	p	r	p	r	p	r	p
SYLL	-.2265	.001	-.2507	.01	-.4350	.001	0	
LENGTH	-.1542	.005	-.1484	n.s.	-.2730	.05	-.0272	n.s.
RED			.2026	.025	.3670	.01	.0094	n.s.
ONAME	.1039	.05	.0223	n.s.	.0590	n.s.	0	

III.D. Summary

The reflection from these analyses to our experimental findings is of interest. Adults found it easier to recognize words with more phonetic content, words to adults, words spoken by girls' parents or by mothers. Predictability from sentence context, which differed by addressee, worked on intelligibility via its association with millisecond length. Parents' words to children were less intelligible because they were shorter than words to adults. But they were also less intelligible for reasons we have not encompassed in these analyses.

IV. Experiment 7

IV.A. Adult Subjects

IV.A.1. Set-hierarchical Analyses

IV.A.1.a. Overall Analyses

Table 5.6 gives the results of the successive addition of Corpus, Type, Token, and Experimental variables to an equation predicting adults' recognition scores for the object names used in Experiment 7.

Neither the Corpus variables nor the Word Type variables were able to produce significant F-values for these object names. Only when Token variables are added does the multiple regression equation account for a significant proportion of the intelligibility variance ($F=2.372$, $df=11,82$, $p=0.013$) or for a significant increase in described variance. While ADD reaches independent significance in the new equation, none of the Token variables taken alone makes a significant contribution. The lowest p, 0.074, is associated with CSPK: as we predicted, words uttered when their referents are absent tend to be easier for the adult Subjects to recognize. The rise in

β for ADD when token variables enter could have to do with suppression of extraneous variance in ADD by CSPK. We will therefore look for an association between the presence of the named object and the addressee.

The addition of CPRS, the experimental treatment, accounts for no further Y-variance to speak of (δR^2=.0069) but increases the β values for ADD and CSPK so that both are significant. Thus we will expect to find some interaction between CSPK and ADD and CPRS.

In short, the variables pertinent to the object names in Experiment 7 account for only a modest (R^2=.2483) but significant amount of variance in intelligibility scores. The independent variables making significant contributions are Addressee and Context at the Time of Speaking.

IV.A.1.b. Effects of Grouping

There were no significant differences between the equations for the two addressees (F=1.001, df=12,70) or for the two stimulus types (F=1.244, df=13,68).

IV.A.2. Relations among Independent Variables.

IV.A.2.a. Duration

Table 5.7 lists β-values for the duration variables (LENGTH, SYLL, and RATE) alone and in combination.

The readiest interpretation of these figures emphasises the role of Length in milliseconds as a predictor of intelligibility. For one thing, only LENGTH produces a significant simple regression equation (1). For another, though LENGTH and SYLL (5) are still redundant predictors (r=.3325, p<.001), RATE, which served to suppress extraneous variance in earlier experiments, is redundant to LENGTH (4) as well (r=.5332, p<.001). Most

TABLE 5.6

Experiment 7: Set-hierarchical Multiple Regression Analyses for Adults' and Children's Recognition Scores

Variable Set	I.V.	Subjects: Adults β (p)	F	R^2	∂R^2
Corpus	CSEX	.172	1.747	.0550	.0550
	PSEX	-.085	(3,90)		
	ADD	.128	n.s.		n.s.
+ Type	CSEX	.168	1.734	.1068	.0518
	PSEX	-.090	(6,87)		n.s.
	ADD	.125	n.s.		
	AGE	.125			
	SYLL	.121			
	KF	-.076			
+ Token	CSEX	.102	2.372	.2414	.1346
	PSEX	-.020	(11,82)		F=2.91
	ADD	.224(.041)	p=.013		(5,82)
					$p<.025$
	AGE	.063			
	SYLL	.186			
	KF	-.000			
	RED	-.162			
	LENGTH	.153			
	RATE	.175			
	CSPK	-.207(.074)			
	CC	-.078			
+ Expt'l	CSEX	.105	2.229	.2483	.0069
	PSEX	-.026	(12,81)		
	ADD	.244(.03)	p=.02		n.s.
	AGE	.073			
	SYLL	.227			
	KF	.001			
	RED	-.148			
	LENGTH	.114			
	RATE	.233			
	CSPK	-.241(.05)			
	CC	-.073			
	CPRS	-.095			

TABLE 5.6 (cont'd)

Variable Set	I.V.	Subjects: Children β (p)	F	R^2	∂R^2
Corpus	CSEX	.098	.460	.0151	.0151
	PSEX	-.058			
	ADD	-.033			
+ Type	CSEX	.114	.886	.0576	.0426
	PSEX	-.056			
	ADD	.026			n.s.
	AGE	.012			
	SYLL	.104			
	KF	-.155			
+ Token	CSEX	.084	4.879	.2013	.1498
	PSEX	.060	(11,82)		F=2.46
	ADD	.142	p=.05		(5,82)
					p<.05
	AGE	-.089			
	SYLL	-.319			
	KF	-.144			
	RED	-.008			
	LENGTH	.670(.045)			
	RATE	-.383			
	CSPK	-.278(.019)			
	CC	.034			
+ Expt'l	CSEX	.083	1.703	.2015	.0002
	PSEX	.062	(12,81)		
	ADD	.139	p=.08		n.s.
	AGE	-.091			
	SYLL	-.326			
	KF	-.144			
	RED	-.011			
	LENGTH	.678(.046)			
	RATE	-.394			
	CSPK	-.272(.032)			
	CC	.033			
	CPRS	.017			

important, no multiple regression equation in this set (1-7) yields a higher R^2 than the simple equation with LENGTH alone.

IV.A.2.b. Context.

Table 5.7 also contains βs for selected multiple regression equations containing variables which reflect the predictability of a stimulus from linguistic and extra-linguistic context, RED and CSPK. A third contextual variable, CC, has been omitted because its simple correlation with intelligibility scores ($r=.030$) is negligible.

While CSPK contributed significantly in the overall equations (Table 5.6), it is not significant in a simple regression (8). We can determine some of the reasons for its rise to predictive prominence by examining the equations containing CSPK and RED (16-19). In each case the β for CSPK is higher in equations with RED than in the corresponding equation (8-11) without RED. The two variables are cooperative suppressors: not unreasonably, words which are 'predicted' by the presence of their referents are less predictable on the basis of their linguistic context ($r=-.1780$, $p<.05$). And, as happened in the earlier experiments, the contribution of RED is reduced when LENGTH enters the equations (12, 14, 16 vs 13, 15, 17). Ultimately (19), RED boosts the β of CSPK while LENGTH takes over the role of RED.

IV.A.2.c. Age of Acquisition and Frequency of Occurrence.

As in Carroll and White's original paper (1973), estimated Age of Acquisition (AGE) and measured frequency of occurrence (KF) have a significant correlation for the object names used here ($r=-.200$, $p<.025$), and the more frequently occurring words are estimated to be earlier acquisitions. Also, Age of

TABLE 5.7

Experiment 7 (Adult Subjects): β-values in Multiple Regression Equations using Duration and Context Variables.

Duration Variables				Context Variables			
iv	β	(p)	R^2	iv	β	(p)	R^2
				8.CSPK	-.120		.0144
1.LENGTH	.356	(.001)	.1271	9.CSPK	-.137		.1459
				LENGTH	.363	(.001)	
2.RATE	.171		.0292	10.CSPK	-.118		.0453
				RATE	.176	(.10)	
3.SYLL	.179		.0322				
4.LENGTH	.371		.1276	11.CSPK	-.139		.1466
RATE	-.027			LENGTH	.381	(.005)	
				RATE	-.032		
5.LENGTH	.340	(.005)	.1289				
SYLL	.046						
6.RATE	.358		.1263				
SYLL	.363						
7.LENGTH	.208		.1357				
RATE	.158						
SYLL	.191						

/continued

TABLE 5.7 (cont'd)

Contextual Variables

iv	β	(p)	R^2	iv	β	(p)	R^2
12.RED	-.254		.0647	16.CSPK	-.171	(.10)	.0929
				RED	-.285	(.01)	
13.RED	-.148		.1463	17.CSPK	-.165		.1089
LENGTH	.305	(.005)		RED			
				LENGTH			
14.RED	-.230	(.05)	.0826	18.CSPK	-.165		.1089
RATE	.136			RED	-.129	(.01)	
				RATE	-.261		
15.RED	-.148		.1466	19.CSPK	-.167	(.10)	.1737
LENGTH	.317	(.01)		RED	-.178	(.10)	
RATE	-.022			LENGTH	.319	(.01)	
				RATE	-.030		

Acquisition is a marginally significant predictor of intelligibility ($r=.182$, $p<.05$) and KF is not ($r=-.105$). Since both show some correlation with intelligibility and with each other, it is not surprising that their β-values in a joint equation are closer to zero than their simple correlations with recognition score (KF: $\beta=.072$; AGE: $\beta=.167$).

But the observant reader will have noted a crucial flaw: the sign for the correlation between AGE and the dependent variable is +. Thus, the later a word is thought to be acquired, the more intelligible it proves. This result offers no comfort to Carroll and White's proposal that early words are 'located' in the more accessible parts of the mental lexicon.

The result becomes a bit easier to understand when we discover that the 'earlier' words are the more predictable from context ($r=-.1745$, $p<.05$) and the shorter both in millisecond length ($r=.2470$, $p<.01$) and in syllables ($r=.3425$, $p<.001$). Thus for word tokens from conversational speech and adult listeners, the estimated age of acquisition is reflected only via its link with Zipf's law: because earlier words are more frequent, they are shorter. And, as we know, shorter word tokens are not the easiest to interpret.

IV.A.3. Correlations with Addressee

Table 5.8 lists the correlations between ADD and CSPK, CC, RED, and LENGTH. These include all the significant correlations as well as all those having a value greater than 0.10

These figures serve a number of purposes. They confirm our earlier suspicions (Chapter 4, Section IV.D) that our child-addressed stimuli were substantially the more likely to refer to objects present at the time. The addressee difference was highly significant, even among pairs of tokens of the same lexical item. The figures also show a tendency for the words to children to be their sentences' sole contentives more often than the words to adults. Both these effects were stronger than the difference in redundancy by Addressee, for the trend to less redundant speech to children only approaches significance at the .05 level.

Finally the absence of LENGTH correlations shows quite pointedly that these materials do not share the strong trend which we found in Experiments 1 and 2 towards shorter words to children. Whether the effect is lost because the length variance is less in the population of object names than in a broader population or whether the change is due to the nonrandom sampling procedure here is moot.

At any rate, these correlations give us reason to return to our consideration of the role of various sorts of contextual redundancy in the creation of an Addressee effect. Words uttered in the presence of their referents were less clear than other object names. Words to children, which were more often uttered this way, were nevertheless *more* intelligible than words to adults. So CSPK makes the wrong overall prediction for words to children. Only RED, predictability within linguistic context, makes the correct prediction. In fact, RED and CSPK are negatively correlated ($r=-.1780$, $p<.05$), so that words produced with their referents present are likely to be *less* clearly articulated by virtue of predictability from physical context and *more* clearly articulated in response to redundancy within immediate linguistic context. As was suggested earlier, linguistic and extra-linguistic redundancy pull the clarity of parental speech in different directions, and the lack of a simple by-materials Addressee effect ($r=.1262$, n.s.) could be due to to these conflicting forces.

The case does not rest there. The set-hierarchical account of adults' performance showed a significant effect for Addressee in equations

TABLE 5.8

Experiment 7: Correlations between Addressee and CSPK, CC, LENGTH, and RED.

Materials:	All (N=94)		Matched (N=46)		Non Matched (N=46)	
Variable	r	p	r	p	r	p
CSPK	.4264	.001	.3780	.005	.4954	.001
CC	.1952	.05	.2750	.05	.1054	n.s.
LENGTH	-.0302	n.s.	-.0164	n.s.	-.0438	n.s.
RED	-.1389	.10	-.1366	n.s.	-.1460	n.s.
KF	-.0315	n.s.	-.1356	n.s.		

containing (and thereby controlling for) CSPK and RED. So while those variables damped a Child Addressee Advantage, some crucial characteristic of object names addressed to children, which made them especially clear, failed to be captured by the independent variables which we have been studying.

IV.B. Child Subjects

IV.B.1. Set-hierarchical Multiple Regressions

IV.B.1.a. Overall Analyses

Table 5.6 contains the β-values in equations successively recruiting Corpus, Token, Type, and Experimental variables to the prediction of children's recognition scores.

The first noteworthy characteristic of these multiple regressions is that they account for a somewhat smaller proportion of the variance (20%) than the equation for adults' scores (25%) and for a good deal less than in Experiments 1 and 2 (35%). In fact these equations are only marginally significant.

Within them, however, we do find regression coefficients with $p<.05$. Though none of the Corpus or Type variables fall in this category, LENGTH and CSPK among the Token Variables do. Just as adults did in Experiments 1 and 2, children found longer words easier to recognize. And like the adult Subjects in Experiment 7, the children did better on words which originally named absent objects.

This analysis of children's responses, though it accounts for only a small proportion of their variance, is, therefore, not unhelpful. It shows that variables which have already been seen to affect adults' scores also figure in children's behavior.

IV.B.1.b. Effects of Grouping.

Data were grouped in three ways here. The grouping by Stimulus Type yielded no reduction of residuals ($F<1$). The grouping by Addressee was also not a significant factor ($F=1.39$, $df=12,69$, n.s.). A third grouping, by CSPK, requires some explanation.

In the overall multiple regression (Table 5.6), CSPK has a sizable effect on children's scores (Absent>Present), while CPRS, the experimental context does not. But the latter had produced a significant effect in the Analysis of Variance (Visible>Hidden) (Chapter 4, Section III.C.3.b) which, of course, had not taken CSPK into account at all. It was thus possible that the observed difference between Hidden and Visible treatments might have been an artifact of an accidental imbalance between them in ratio of Referent-Present to Referent-Absent words. When we consider that the overall correlation between CPRS and CSPK is -.3411 ($p<.001$), that is, that more Referent-Absent words belonged to the Visible Condition[4], our suspicions are further aroused.

To see whether CPRS itself had any effect, another multiple regression was run with only CPRS and ADD as independent variables, and with CSPK as a grouping factor. The Referent-Present and Referent-Absent equations differed ($F=4.244$, $df=3,88$, $p=.008$) in two ways. First, the intercept was higher for Referent-Absent (2.425 vs 1.152). Second and more important, the *sign* of the β for CPRS differs between groups: for words originally spoken without their referents, the Hidden condition was better than the Visible ($\beta=-.362$, $t=-2.453$, $df=44$, $p=.019$), while for words spoken in the presence of their referents, the Visible condition was the better ($\beta=.279$, $t=1.992$, $df=48$, $p=0.52$). Addressee *per se* does not contribute significantly in either case ($\beta=.170$, $\beta=-.031$). The means and cell sizes for the CSPK x CPRS interaction are found in Table 5.9, and they show that we have been concerned about the wrong artefact. Words in the Presentation-Visible condition were not the more intelligible because they were largely Referent-Absent words, for Referent-Absent words in this condition (Presentation-Visible) scored quite low. We must owe the Visible Advantage to the clarity of Referent-Present Presentation-Visible words and to the unintelligibility of Referent-Present Presentation-Absent words.

Such Visible Advantage effect as we found in Experiment 7, then, should come from sub-cells with many Referent-Present words, and of course it did: the reader may recall that the Visible condition was better than the Hidden only for words spoken to children (Chapter 4, Section III.C.3) and that words to children were largely uttered in the presence of their referents (Table 5.8). So we appear to have found a Visible Condition Advantage because we had so many words with present referents among our words to children. This fact accounts for the extraordinary intelligibility of Visible condition words to children, which we were previously unable to explain, and in part for the Addressee effect in favor of child words.

The CSPK x CPRS interaction itself is mystifying in the extreme but it does have the advantage of being naturalistic: it implies that the word tokens are best identified in the sort of extra-linguistic context in which they are produced. And as the production and perception contexts are the same for 'live' speech, this is also a fortunate conclusion.

IV.B.2. Relations among Variables

IV.B.2.a. Duration

Table 5.10 contains an account of the interrelationships among duration

TABLE 5.9

Experiment 7 (Child Subjects): Means and Cell Sizes for the CSPK and CPRS Interaction.

	CSPK			
	Referent Present		Referent Absent	
CPRS	Mean	n	Mean	n
Toys Visible	1.882	17	1.533	30
Toys Hidden	1.073	33	2.286	14

variables. It shows once again that their role in predicting children's scores is much what it was for adults listening to the same words.

A word's millisecond LENGTH is the most important single predictor of its successful recognition (1) and none of the combinations of duration variables (2-7) significantly improves on the proportion of variance accounted for by LENGTH. Again, RATE is a net suppressor for LENGTH, so that for children too, LENGTH with RATE partialled out (or amount of phonetic material), has the highest correlation with intelligibility. Once again LENGTH and SYLL are redundant measures of duration while RATE and SYLL are cooperative suppressors.

IV.B.2.b. Context

None of the contextual variables (Table 5.10) is a significant individual predictor of children's scores. CPRS and CSPK are redundant (compare (8) with (35)) while CC & RED operate as suppressors of some of CSPK'S irrelevant variance ((17) and (43)). This tendency of Referent-Present words to be less predictable from their linguistic contexts and to be sole contentives has hidden part of CSPK's real effect on children's scores.

When contextual and duration variables are combined (Table 5.10), all we find is an enlargement of the same picture. Only equations including LENGTH make any gain in R^2 over the simple regression of children's scores on LENGTH itself and none of the gains reach significance. But by perusing the equations containing CSPK, we can begin to see how it rises to prominence in the overall equation: all the other variables except CPRS (35) and RATE (11) suppress some of its extraneous variance. Even LENGTH, for once, is not redundant to a contextual measure, but (just as it did for adults, Table

TABLE 5.10

Experiment 7 (Child Subjects): β-values in Multiple Regression Equations Using Duration and Context Variables.

I.V.	β (p)	R^2	I.V.	β (p)	R^2
			8. CSPK	-.155	.0241
1. LENGTH	.348(.001)	.1210	9. LENGTH	.356(.000)	.1506
			CSPK	-.172	
2. SYLL	.144	.0208	10. SYLL	.148	.0460
			CSPK	-.159	
3. RATE	.153	.0253	11. RATE	.152	.0471
			CSPK	-.154	
4. SYLL	.020	.1213	12. SYLL	.021	.1510
LENGTH	.341(.002)		LENGTH	.349(.001)	
			CSPK	-.172	
5. SYLL	.312(.009)	.0936	13. SYLL	.315(.008)	.1189
RATE	.318(.008)		RATE	.318(.008)	
			CSPK	-.159	
6. LENGTH	.376(.002)	.1229	14. LENGTH	.389(.001)	.1532
RATE	-.052		RATE	-.061	
			CSPK	-.175	
7. LENGTH	.542	.1256	15. LENGTH	.604(.042)	.1593
SYLL	-.178		SYLL	-.231	
RATE	-.236		RATE	-.300	
			CSPK	-.182	
			16. CC	.087	.0076
			17. CC	.148	.0440
			CSPK	-.200	

/continued.

TABLE 5.10 (cont'd)

I.V.	β (p)	R^2	I.V.	β (p)	R^2
18. CPRS	.080	.0064	27. RED	-.150	.0224
19. LENGTH	.346(.001)	.1257	28. LENGTH	.337(.002)	.1219
CPRS	.069		RED	-.032	
20. SYLL	.150	.0289	29. SYLL	.127	.0380
CPRS	.090		RED	-.133	
21. RATE	.145	.0270	30. RATE	-.126	.0389
CPRS	.060		RED	.131	
22. SYLL	.026	.1263	31. SYLL	.020	.1222
LENGTH	.336(.002)		LENGTH	.329(.004)	
CPRS	.071		RED	-.032	
23. SYLL	.311(.010)		32. SYLL	.294(.018)	.0968
RATE	.309(.011)		RATE	.297(.018)	
CPRS	.056		RED	-.059	
24. LENGTH	.381(.002)	.1286	33. LENGTH	.365(.004)	.1237
RATE	-.065		RATE	-.051	
CPRS	.264		RED	-.031	
25. LENGTH	.584(.054)	.1340	34. LENGTH	.528	.1272
SYLL	-.218		SYLL	-.175	
RATE	-.293		RATE	-.232	
CPRS	.089		RED	-.029	
26. CC	.096	.0155	35. CC	.040	.0238
CPRS	.090		RED	-.136	

/continued

TABLE 5.10 (cont'd)

I.V.	β (p)	R^2	I.V.	β (p)	R^2
36. CSPK	-.145	.0250	43. CSPK	-.188	.0566
CPRS	.031		RED	-.183	
36. LENGTH	-.356(.001)	.1507	44. LENGTH	.334(.002)	.1543
CSPK	-.169		CSPK	-.183	
CPRS	.011		RED	.065	
37. SYLL	.150	.0474	45. SYLL	.127	.0725
CSPK	-.145		CSPK	-.188	
CPRS	.041		RED	-.167	
38. RATE	.151	.0472	46. RATE	.123	.0711
CSPK	-.151		CSPK	-.183	
CPRS	.007		RED	-.160	
39. SYLL	.022	.1511	47. SYLL	.021	.1547
LENGTH	.348(.001)		LENGTH	.326(.004)	
CSPK	-.168		CSPK	-.183	
CPRS	.013		RED	-.066	
40. SYLL	.315(.009)	.1189	48. SYLL	.287(.02)	.1265
RATE	.318(.009)		RATE	.286(.021)	
CSPK	-.159		CSPK	-.175	
CPRS	.001		RED	-.093	
41. LENGTH	.390(.001)	.1535	49. LENGTH	.367(.003)	.1568
RATE	-.064		RATE	-.060	
CSPK	-.168		CSPK	-.185	
CPRS	.019		RED	-.065	
42. LENGTH	.616(.041)	.1601	50. LENGTH	.578(.054)	.1627
SYLL	-.242		SYLL	-.226	
RATE	-.316		RATE	-.295	
CSPK	-.172		CSPK	-.192(.057)	
CPRS	.030		RED	-.063	

/continued

TABLE 5.10 (cont'd)

I.V.	β (p)	R^2	I.V.	β (p)	R^2
51. CPRS	.105	.0332	59. CSPK	-.172	.0567
RED	.019		CPRS	.050	
			RED	-.188	
52. LENGTH	.329(.002)	.1275	60. LENGTH	.332(.002)	.1546
CPRS	.076		CSPK	-.117	
RED	-.046		CPRS	.019	
			RED	-.068	
53. SYLL	.133	.0504	61. SYLL	.130	.0753
CPRS	.111		CSPK	-.169	
RED	-.150		CPRS	.057	
			RED	-.172	
54. RATE	.116	.0458	62. RATE	.118	.0718
CPRS	.085		CSPK	-.173	
RED	-.142		CPRS	.029	
			RED	-.164	
55. SYLL	.027	.1281	63. SYLL	.023	.1550
LENGTH	.319(.006)		LENGTH	.323(.005)	
CPRS	.078		CSPK	-.176	
RED	-.048		CPRS	.021	
			RED	-.068	
56. SYLL	.288(.021)	.1014	64. SYLL	.268(.021)	.1266
RATE	.282(.027)		RATE	.283(.025)	
CPRS	.070		CSPK	-.171	
RED	-.073		CPRS	.014	
			RED	-.095	
57. LENGTH	.365(.004)	.1305	65. LENGTH	.367(.004)	.1575
RATE	-.066		RATE	-.065	
CPRS	.085		CSPK	-.176	
RED	-.047		CPRS	.027	
			RED	-.068	
58. LENGTH	.567	.1357	66. LENGTH	.591(.052)	.1639
SYLL	-.216		SYLL	-.240	
RATE	-.292		RATE	-.315	
CPRS	.096		CSPK	-.180	
RED	-.045		CPRS	.039	
			RED	-.068	

5.7), cooperatively suppresses some CSPK variance (9). Ultimately then CSPK is a major as opposed to a minor predictor of children's scores (Table 5.6) because it is associated with but not redundant to the other variables.

IV.B.2.c. Frequency and Age of Acquisition

Estimated Age of Acquisition and Kucera and Francis (1967) frequency have little to do with children's word recognition in this experiment. Neither individually (KF:β=-.162, R^2=.0262; AGE:β=.081, R^2=.0065) nor in combination (KF:β=-.153, AGE:β=-.050, R^2=.0289) do they account for a significant proportion of word recognition variance.

IV.B.3. Correlations with Addressee

Because the Addressee trends for child Subjects differed from Matched to Nonmatched Words, the correlations for the two Stimulus Types are listed separately in Table 5.8

The important predictors from the hierarchical equations do not directly account for the Addressee effects in children's performance. LENGTH in milliseconds shows virtually no addressee trend. CSPK, negatively correlated overall with recognition, might help to explain the fact that children found Matched Words to the adult easier, because these words were more likely to be uttered with referent absent. The same CSPK effect, however, holds for Nonmatched Words where, taken alone it makes the wrong prediction, for child-addressed words were easier here. It is also rather uncomfortable that the only predictors of this Addressee effect, the smaller mean RED value and the higher proportion of unique contentives in words to children, do not actually produce significant r's with ADD or significant βs for recognition scores.

To find the cause of children's Addressee effects, then, we should probably return to the CSPK x CPRS interaction. It was in the Nonmatched words originally spoken to children that we found the highest recognition scores and the greatest advantage for Presentation-Visible. We might suppose that the strong tendency here for words to children to have been spoken with Present-Referent ($r=.4954$, $p<.001$) made the Visible condition score particularly high and thereby carried the Addressee effect.

IV. C. Summary

At first glance, the analyses of stimulus variables in Experiment 7 might seem less productive than the comparable work on Experiments 1 and 2. After all, the regressions for Experiment 7 accounted for less of the variance in recognition scores (20% for children and 25% for adults vs 35%) and uncovered fewer important predictors (ADD, LENGTH and CSPK vs ADD, CSEX, PSEX, RATE, LENGTH) than the earlier work. What these analyses have uncovered, however, goes some way toward explaining issues which we were previously forced to leave open.

First of all, these results emphasize that children and adults are similar sorts of speech perceivers. While we may be covering less of children's behaviour with the independent variables studied in this chapter, the influence of task factors on children's behaviour in language experiments is always sizable (see Elliot, 1981, for a review) and the present analyses ignore those. Though adults show more sensitivity than children to Corpus variables, the major stimulus predictors of children's scores have the same functions and interrelations as they do for adults. Like the adults in Experiments 1 and 2, children in Experiment 7 did significantly better on words of greater duration, and the same trend was shown on the same words by the adult controls. For both groups, words spoken in the absence of the things they named were easier to recognize. For all subjects, too, the role attributed to redundancy in sentence context was actually mediated through word length, because the more predictable (and generally less intelligible) stimuli were also the shorter ones. For all subjects, moreover, RATE was a net suppressor of LENGTH and therefore words containing more phonetic/acoustic material, regardless of its rate of delivery, were more readily identified. For all subjects, millisecond length and syllable length were redundant, with the former the stronger predictor, despite the fact that children are reputed to be more sensitive to syllables than to other units (Mehler, Segui, and Frauenfelder, 1981). For all Experiment 7 Subjects, Context of Speaking and Length were cooperative suppressors, as each accounted for some of the variance in the other which did not help to predict stimulus intelligibility.

Second, our study of the CSPK variable has produced a plausible account of the pattern of children's results. While words referring to absent objects were generally easier to recognize, and while the words presented with toys Visible happened to include a majority of these, the Context of Presentation effect was not just a Context of Speaking effect in disguise. We found that words uttered with referents absent were clearer only in the matching CPRS condition (Hidden). Where referents had been Present, words heard with toys Visible scored higher. Since children had been best at words spoken to children and presented in the Visible condition, the obvious link was the fact that our sample of object names spoken to children was largely composed of Referent-Present words. Consequently, what might have passed for a true Addressee effect or a simple Context of Presentation effect was something more complicated.

However neat this new account, it does offer us a very untidy problem:

explaining it. We could, of course adduce some new independent variable, perhaps a characteristic of intonation or a change in voice quality, which is habitually used for names of items which are 'given' by the physical environment. Were children sensitive to this parameter, its presence might instruct them to search visually for an item whose name was close enough to an imperfectly perceived stimulus to impose an identity on it. But though this account might explain why Present-Visible stimuli score high, it offers no explanation for the high scores among Absent-Hidden words. Perhaps a better hypothesis would return to the simple effect of CSPK itself. If word tokens having absent referent objects are particularly intelligible, the child will do better to devote his attention to their speech sounds, undistracted by a set of interesting toys. If the stimulus is acoustically unhelpful, as Referent-Present words should be, the listener needs all the help he can get and hints from an array of toys are better than nothing[5]. We need add to this only a bias in favor of using extra-linguistic information. Now we can predict that the child will perform profitably on Referent-Present words by dint of his bias, so long as we give him objects to scan, but that he will behave counterproductively on Referent-Absent words unless we remove the distractions from view.

Whatever explanation we offer, the effect in question does not contradict the conclusions of Chapter Four. Children clearly can use physical contexts in word recognition because the object names spoken to them may be so unclear that they must. What we have added now is the observation that some of the lack of clarity is due to the very situation which allows 'extra-linguistic' speech processing; the presence of the object under discussion.

V. Conclusions

The analyses of this chapter actually do more than iron out a few wrinkles in the experimental results: they enlarge our appreciation of the notion of intelligibility and our understanding of the Addressee effects which we have found.

In part our results confirm the intelligibility experiments from the late 1950's and early 1960's. Longer words from conversational speech, like longer citation forms,were easier to identify (Rubenstein *et al.* 1959). Speech rate *per se* made little difference (Pickett and Pollack, 1963). Often, however, present results contrast with or supplement earlier findings. For our stimuli, the frequency of occurrence variable which early studies stressed, is not particularly helpful, perhaps because samples of conversational speech do not provide the range or balance of frequency bands designed into the work on citation forms. The analyses in this chapter have added to Lieberman's (1963) account of sentence-based redundancy the observation that it works on intelligibility largely via the word's length. We can also see quite clearly now that the independent relevance of word length and irrelevance of speech rate imply that the crucial variable is the amount of phonetic/acoustic material in the word token. We have added to the predictors of intelligibility an object name's extra-linguistic context. Apparently, speakers can adjust a word's intelligibility both to its degree of linguistic redundancy and to its predictability in external circumstances.

Beyond these correlates of intelligibility are others which we have not described. In the final account of adults' scores for example, we found Addressee effects which cannot be merely the result of differences in other variables with Addressee because they did not disappear in equations containing all the other variables. And, in Experiments 1 and 2 we also retained effects in favor of the speech of mothers and of girls' parents. Given these findings, the notion of intelligibility must be richer than any composite of the Type, Token, and Experimental variables explored here. It remains to be seen whether the effects of ADD, PSEX, or CSEX could be mapped onto pitch or intonation measures, or whether they remain unspecified by anything but the recognition scores which form an operational definition of intelligibility itself.

Of course, though some constituents of the Addressee effect continue to elude us, others were plainly displayed in our analyses. By examining the variables which both correlate with Addressee and appreciably affect intelligibility, we saw that randomly sampled words to children (Experiment 1) were less intelligible than words to adults, not only because the former were more predictable from their sentence contexts, but also because they were shorter in both millisecond and syllable length. Thus, by creating more redundant messages and by using suitably shorter words, parents help to ensure the general unintelligibility of their speech to their young children. In producing the object names of our Experiment 7 sample, moreover, parents failed to create markedly clearer words for children for at least two reasons. They used words of roughly the same length as those to adults thereby failing to recruit the length variable to the service of parentese, and they employed these words by and large, to discuss things which were present at the time. Of course, in this instance, the informants were following instructions. But if we are to believe that those instructions were unnecessary, we perceive a more general problem. Since names of present items are less intelligible, parents' practical choice of things to discuss with children also does nothing to increase clarity. And finally, such tendency as parents showed towards greater redundancy in sentences containing object names for adults was not strong enough to create a significant advantage for child-addressed words across all materials. Insofar as parents can be seen to have word intelligibility under their control, they fail to take up the options that would enable a child to process speech from its acoustic information alone.

From other points of view, their failure makes very good sense. By using shorter words to children, in general, parents may avoid phonological objects too complex for children to analyse and produce themselves. By using more redundant sentences and by sticking to the present and perceptible, they may increase the chances that an inattentive listener receives some of the message. But our findings show even more strongly than Lieberman's that speech is a thing full of swings and roundabouts: what a speaker provides by way of linguistic or extra-linguistic support for a word, he takes away from its own intelligibility. Whatever parents do for their children, they do not escape from this pattern. As we have seen, they do not add acoustic precision to contextual specification and they fail to make it easy to learn language from the bottom up.

Footnotes

1. Several potentially interesting token variables were not included because of the technical difficulties involved in their measurement. While it would have been useful to know whether random samples from parentese and adultese contain different proportions of words carrying tonic stress and whether tonic stress affects intelligibility in the same way for both, the trained phoneticians whom we asked to listen to tapes and mark tonics on transcript

samples found the task too difficult to complete. Their failure is not particularly surprising in view of the differences between conversational speech and the sorts of examples provided in the literature or in training exercises (Brown, Currie, and Kenworthy, 1980). It would also have been helpful to know whether the present materials replicate the usual finding that parentese is marked by higher F_0, greater F_0 range and more pitch movement than other speech (Remick, 1971; Garnica, 1977). A serious attempt was made to take the necessary pitch measurements, first on a pitch computer and then via the ILS Speech Signal Processing package (Interactive Laboratory System, Version 3, 1979) mounted on the Phonetics Laboratory DECLAB PDP 11/40 minicomputer.

The former proved to be unacceptably inaccurate and the latter theoretically over-determined. The ILS routines for F_0 extraction (API, SIF) were unable to operate accurately during those considerable portions of the stimuli which displayed quasi-dysphonic characteristics involving dysperiodicity. As it has been generally supposed that normal individuals produce much less dysperiodicity during voicing than appears in our samples (and others: see Laver *et al.*, 1982), these routines simply fail to return accurate measurements for any pitch period in which a secondary peak confuses their heuristics for estimating the temporal distance between peaks. Since our stimuli were nearly all under a second in length, these failures would have covered a high enough proportion of each stimulus to invalidate the descriptive statistics for F_0. The only way to circumvent this problem (marking each individual pitch peak by eye on a visual display of the sampled data and calculating F_0 from the list of inter-peak intervals) would have demanded much more time than it promised to merit.

2. This parallels Pickett and Pollack's (1963) findings in an experiment where speech from fast and slow speakers was presented in ever longer samples. Regardless of speech rate, the amount of structural information in the stimulus determined its intelligibility.

3. It is interesting that Parent Sex shows similar correlations. In speaking to children, mothers, whose words proved more intelligible, produced longer words ($r=-.2465$, $df=142$, $p<.01$) than fathers and spoke more slowly ($r=-.2650$, $df=142$, $p<.01$) as well. These correlations were much less marked in speech to adults (-.0616 and -.0338 respectively). Not surprisingly mothers speech was also less redundant ($r=.2026$, $df=94$, $p<.025$) than fathers.

4. The dependent variable for these analyses covered only the treatment conditions which adults and children shared, i.e. on the adult design which had CPRS as a between-words measure. The results of the following analysis are, however reflected by trends in analyses of the full child Subject design in which CPRS was tested within words.

5. I owe this idea to Anne Anderson.

CHAPTER SIX: Conclusions

I. Summary

The work of this dissertation was originally intended to protect the assumption that most, if not all, of what is said to a young child functions as usable linguistic input. If it does not, if the proximal linguistic stimulus comprises only a small fraction of the distal stimulus, then common views of first language acquisition become difficult to maintain. Theories which depend on the features or feature-ratios of parental speech, will become as awkward as theories which suppose that the child can work his way steadily through adult strings and discern in them patterns or segments or morphs. But the current work has failed to protect these theories, for it tends toward the conclusion that many words in parental speech should be unintelligible to a child who must identify them from their acoustic realizations.

We come to this point by way of two hypotheses which offered reasons to believe that young children might not be subject to the unintelligibility of normal speech. The first of these, which we called the Intelligibility Hypothesis, proposed that adult-child speech is much clearer word for word than the adult-adult speech on which Pollack and Pickett's observations were made. The second included as varieties of a Perception Hypothesis a set of proposals for special perceptual capacities or strategies in children which could counteract the effects of articulatory shortcomings in adults. Neither of these hypotheses has withstood experimental tests well enough to offer any resistance to the Pollack and Pickett effect.

I.A. The Intelligibility Hypothesis

We found that the speech of a number of parents to their two- and three-year-old children showed the opposite of the effect which the Intelligibility Hypothesis predicts: words excerpted from speech to children were very significantly less intelligible than words from speech to an adult. Because this result was stronger for randomly selected words than for paired tokens, we concluded that the Child Disadvantage was likely to be more closely associated with the words used than with their pronounciation, though pronounciation also had a role to play. Of course, the strong finding for the random sample gave the greater chance that the result was truly representative of its population.

The Child Disavantage did not reappear for the same taped words presented in running speech: here our adult listeners, like other transcribers of motherese, found that speech to children, was very clear (91% correct), if anything, clearer than speech to adults. Since this was the accepted view of parentese, we had to ask why it differed from the results for isolated words and why parents, whose intentions are assumed to be helpful, should produce such a degraded signal when they speak to young children.

The answer to both questions had to do with well-attested characteristics of parentese which have repercussions for the intelligibility of individual words. Parentese is known to be more redundant than adultese in many ways, and we found that randomly sampled parentese words were more predictable from their sentence contexts than comparable words from adultese. But words which were more predictable in context were less intelligible in isolation and so any gain in sentential redundancy was offset by a loss in acoustic clarity. Pursuing this finding via multiple regression analysis, we learned that the effects of intrasentence redundancy on word intelligibility were mediated by the duration of the stimulus word. More predictable stimuli were shorter and shorter stimuli, or more precisely shorter stimuli at a constant speech rate, were less intelligible. Parents used significantly shorter words to children than to adults, thus ensuring that their speech to children would be the less intelligible. Our informants maintained another characteristic of motherese: they spoke about objects which were present at the time. The names of present objects were, however, dependably less intelligible than the names of absent ones. Any gain in extra-linguistic redundancy achieved by having the referent available to the child's senses, must be at least partially counterbalanced by a concurrent loss in clarity of the referring word.

Parents should not be thought to adopt these features out of spite, for each is potentially useful. With an inattentive or a perceptually handicapped listener a redundant message may ensure that some message is received. Because short words occur more frequently in the language, parents may assume that the child can or should have mastered them very early. Since two-year-olds seem more interested in present than in imaginary or absent things, parents may feel that they have a chance of attracting the child's attention if they keep to the here and now. The fact here is, however, that if a parent opts for any of these features he is *thereby* reducing the intelligibility of his speech. The moral in our investigation of the Intelligibility Hypothesis must be that parents do not dissociate the word-for-word clarity of their speech to children from factors which would normally control it.

It is not particularly surprising that they do not. The parents themselves doubtless consider their speech to their children particularly intelligible. And to them it is: all adults hearing parentese strings will use its linguistic redundancy to compensate for its acoustic failures. When a speaker adjusts the amount of acoustic detail in a word token to its local redundancy, he seems to be declaring his expectation that they will do so.

In fact, we could propose that the relationships among intrasentential predictability, word intelligibility in isolation, and the perception of words in context imply the existence of a variety of speaker-hearer contract (Clark and Clark, 1977). The agreement here is based not on a common grasp of the rules of discourse but on a common perceptual mechanism. What the hearer can glean from one source of information, the speaker can omit from another, because both produce perceptual objects by integrating information from the same sources. This contract is not a matter of polite gifts of information and well-bred acceptance of them: it seems to be a matter of perceptual necessity.

From the hearer's point of view the necessities are readily discerned. It has been noted that listeners must somehow integrate different sorts of linguistic information in order to recognize speech (Cole and Jakimik, 1980; Marslen-Wilson and Tyler, 1980). What the speaker-hearer contract implies is that 'interactive processing', as Marslen-Wilson and Tyler call it, is necessary in speech recognition because a parallel interaction takes place in speech production[1]. The speaker's integration of semantic, syntactic, lexical, and articulatory information so affects the acoustic signal that the hearer has no choice but to call on all these sources to determine what is being said.

The necessity for integration of these sorts of knowledge on the speaker's part may be harder to detect. We can make two proposals about the nature of the speaker to help to explain the situation. First, as a normal hearer, an adult cannot perceive acoustically based intelligibility directly. Second, because a speaker uses his hearer's mechanisms on his own speech, he cannot control intelligibility directly.

Let us expand the first proposal about the perception of 'true' or

While it would be unreasonable to claim that adults cannot control the clarity of their speech at all,

articulatory clarity. all the circumstantial evidence suggests that they do not have sufficiently direct perceptions to judge clarity of articulation independently of intelligibility in context. As we have seen, the two can be very different.

Anecdotal examples abound of failure to distinguish between the sounds in a word token and what a word token sounds like in context. Those researchers we have so often mentioned who reported that motherese is clearly articulated, but who actually found that they seldom failed to transcribe its sentences fully, must have believed that the report paraphrased the finding. The difficulty appears to be that the same recorded word token, the same acoustic information, *sounds different* in and out of context. Subjects listening to our artificially isolated words, even those sufficiently trained in phonetics to know better, were often unable to believe that these were the sorts of sounds they heard in normal speech[2]. Even after making the tapes and listening to them numerous times, we ourselves were unable to force many stimuli to assume word identities. The most striking demonstration of the phenomenon can be made using Pickett and Pollack's (1963) technique. When the first, the first two, the first three, etc. words of an utterance are presented in sequence, the listener can mark the point where the unintelligible sounds he has been listening to transform themselves into a 'clear' string of words. The experience is always a revelation.

If adults cannot monitor 'true' intelligibility on-line for other people's speech, they ought to be similarly handicapped in perceiving their own. Thus, our second proposal, that the speakers cannot control their word-for-word intelligibility directly, translates into the suggestion that they control it indirectly, via the other sorts of information which in perception are integrated with the acoustic signal. The correlates of intelligibility with which we have been concerned will be by-products of features which speakers can control more directly.

The consequences of this proposal are not intuitively displeasing. Word intelligibility correlates with amount of acoustic/phonetic information and we have seen that this can be varied both within and between word types. Within a word type, the differences, as in Lieberman's (1963) materials, should be direct consequences of the predictability of the word token in sentential context. It makes sense to suppose that the content and structure of the sentence are chosen first and that the articulation follows, especially since we have no indication that a speaker could set a level of articulatory clarity and make structure and meaning follow that. Between words, as we suggested in Chapter Three, differences in amounts of acoustic/phonetic material are related to semantic complexity and frequency of occurrence. Again it is reasonable to suppose that a speaker should choose his words because they they can add appropriate elements to the meaning of an utterance or because, as concominants of their frequency of occurrence, they belong to a suitable style or register. And it seems counterintuitive that he should choose long words to be maximally intelligible. In both cases, then, the features which make for intelligibility are not accessed directly: they would seem to follow from more controllable choices.

Now let us return to the issue of speech to small children. If parents' own speech perception dictates the bottom-up clarity of their speech, we can hardly expect them to dissociate word- from message-intelligibility in the way our hypothesis required. Adult-child speech must display a stronger Pollack and Pickett effect than adult-adult speech as a direct result of the increased redundancy and decreased lexical complexity which parents arrange in what they hope will be a helpful way. Because their perceptual systems are unlikely to match those of the child listeners, and contrary to popular superstition, some things parents do in speaking to children will be no help at all.

I.B. The Perception Hypothesis

At this point we must turn to the suggestion that young children differ perceptually from adults in ways which will protect them from the ill effects of their parents' well-meaning adjustments. Whatever children may lack in running speech processing, our findings tend to show that they resemble adults in the appreciation of experimentally isolated words.

Three-year-olds were certainly not immune to the difficulties of recognizing words on acoustic grounds alone. They were generally worse than adults at recognizing excerpted names of objects (39% vs 80% correct). While it is not obvious how much of this difference was due to response strategies specific to the experimental task and how much to real perceptual difficulties, we cannot interpret this result as in any way supporting the Perception Hypothesis.

Nor are we encouraged by the outcome for two other versions of this hypothesis. Children did not prove impervious to the difference between pronounciation of words in isolation and in spontaneous speech. They found the latter very much more difficult to identify (40% for segmented vs 78% for citation forms). Nor did children show any special propensity for recognizing child-addressed words. For object names, they showed a Child Addressee Advantage less often than adults did. The adults tended to do better on both child-addressed members of Matched Pairs and child-addressed Nonmatched Words. But children actually found the Matched pronounciations to be significantly harder to recognize. Only for the set of lexical items forming the Nonmatched Words to children was there any perceptual advantage. And as we shall see, even this may be explained without reference to parentese *per se*.

The Child Addressee Advantage in Nonmatched Words was associated with a variable which we tested in another version of the Perception Hypothesis. We had proposed that children could not use the here-and-now quality of parental speech to suggest possible identities for word tokens. The stimuli appeared to gain in intelligibility when presented with the set of named toys in full view. Effects of extra-linguistic context were most marked for words originally addressed to children and the effect worked over successive presentations of the same stimuli. Even with the help of extra-linguistic context, however, the child-addressed words were only 53% correct.

The multiple regression analyses of children's responding helped to explain their limited success. Words to children had indeed been uttered in the presence of the objects they named more often than not. Though this finding bodes well for the children's ability to use extra-linguistic context, it also suggests that they have to do so. Words predicted by the physical presence of their referents, like words predicted by their sentence contexts, tended to be less intelligible. Just as adults may have to use higher order linguistic information to compensate for its detrimental effect on word delivery, children may be impelled to use extra-linguistic context to offset its effects on clarity. Though parent and child may be negotiating for a speaker-hearer contract here, the advantages of extra-linguistic information to the child do not yield a return as great as the parent's loss of articulatory precision. The results were, after all, recognition scores of only 50%.

Despite the limitations of extralinguistic context, the multiple regressions suggest that children have a strong bias toward using it. This point comes from the interaction of contexts of speaking and presentation. We found that words uttered in the presence of their referents were better recognized if the set of toys was visible when the child tried to identify them, but words uttered in their referents' absence were better when no toys could be seen. This asymmetry could be simply explained were the child to have a constant bias toward the use of extra-linguistic context and away from acoustic processing. The referent-absent words were, on average, the more intelligible. If children did worse on these than on referent-present words as they did when the toys were visible, they must have been missing some of the acoustic clues to the words' identity. By removing the toys, we forced the children to process sound alone and they improved. For the relatively unintelligible referent-present words, on the other hand, the extra-linguistic bias was profitable. As most child-addressed object names can be supposed to fall in this class, the children were only doing what the deprivations inherent in parental speech would have taught them to do. We could, of course, test the bias toward extra-linguistic information. By expressly crossing our Context of Presentation factor (Visible vs Hidden) with Context of Speaking (Refeerent Absent vs Referent Present) and with intelligibility for adults (High vs Low), we might see whether the presence of the named objects was detrimental to the recognition of all the very intelligible words, regardless of the presence of the referent when they were originally uttered. Though it might tell us something about the child's ability to use acoustic/phonetic information, this experiment is not really necessary to convince us that children will attend to non-linguistic cues.

The present work aside, a bias towards interpreting extra-linguistic context rather than the linguistic signal has been found numerous times. Children have often been seen to interpret sentences as referring to likely events and sensible real-world relationships for the objects in question, whatever linguistic forms are presented (Strohner and Nelson, 1974; Carey, 1978). Indeed Shatz (1978a and b) suggests that early sentence processing might amount to no more than a search in the linguistic signal for the names of an available object and a plausible action to perform on it. One might wish to conclude with such writers as Clark (1974) that the dependence on extra-linguistic context is the child's distinguishing perceptual characteristic and his own toddler-sized *divillus ex machina*.

To do so might be rash. The multiple regression analyses which showed that both adults and children found words with more acoustic/phonetic content to be more intelligible also showed that both did better on words which were uttered with referents absent. Even though the adult subjects failed to show a context-of-presentation effect, we can still argue that adults can integrate extra-linguistic and acoustic information. To support this let us first reiterate our explanation of the failure of the Context effect in adult subjects. In Chapter Four, we conjectured that their excellent performance in Experiment 7 may have been due to a feat of memory which kept the toys visible to the mind's eye when they were hidden from the body's. A Context effect should reappear when the mnemonic approach to the task becomes unfeasible. In more demanding tasks than ours, with much longer referent sets, for example, adults should show the same effects of physical context as children.

A more important argument recalls our discussion of the speaker-hearer contract in intelligibility. We have noted that speakers do to intelligibility what their hearers can be expected to undo. As adults seem to adjust word intelligibility to at least one sort of extra-linguistic redundancy, the implication is that other adults will make the appropriate integration in perception.

A plausible conclusion for our discussion of the Perception Hypothesis might therefore run as follows. As far as we can see, the child has no special perceptual abilities which will undo the Pollack and Pickett effect in parental speech. He does have a capacity to profit from the extra-linguistic context of speech but this may differ from a similar ability in adults only in the degree to which the degraded nature of parental speech and the child's other processing limitations force him to use it.

II. Implications

The view just summarized contrasts strongly with the picture usually drawn of a young language learner's relationship to his environment. The literature on motherese, indeed on parents' roles in all of cognitive development, tends to portray the human child figuratively as the center of attention in an affluent home where his every developmental need can be foreseen by perspicacious and sensitive adults and supplied from their bountiful resources. Whether those resources were provided as family birthright or developed through the parents' self-education in 'parenting', the child who receives his full share of adult attention is thought to lack for nothing. Yet our conclusions paint the young language learner as a prototypical street urchin, surviving without parental care, deprived of much that he needs, and always resourceful and alert in his search for scraps. Since we know that children do survive as language learners, we ought to ask now, how they do so.

First of all, we should consider what the child actually manages by way of day-by-day speech perception in the early stages of language acquisition. Our findings and the idea that children have little higher order linguistic knowledge at the start argue that the child can recognize few of the words said to him. Disregarding the words he does not yet know, 30% of the remainder is an optimistic assessment of what he should recognize. Of course, this does not mean 30% of each word: some word tokens will be perfectly clear. We can assume that the percentage of intelligible words will rise among words which both refer to objects, actions, and states present to the senses and contain enough phonetic material to exceed some minimum. For these words we might expect 50% intelligibility. This may not be the odd scrap, but it will not amount to a full linguistic diet either.

If the child has access to such limited linguistic rations, we may ask why adults generally suppose that he is processing whatever is said to him. Partly, we know that he gives deceptively correct responses to language because he is clever at reading the surrounding situation. He may often be reading the situation directly, and using the existence rather than the content of an adult utterance to signal that he ought to look for a situationally appropriate response. If parents repeatedly say the same things in the same situations, they may be helping the child to appear to understand rather than directly helping him to discern individual word meanings. All he has to do is learn the response that the situation demands (see Donaldson, 1978; Clark *et al*, 1972). When he does actually recognize words, he may follow a similar extra-linguistic strategy as Shatz (1978a and b) suggests, performing the named action on the named and available object regardless of the form of the utterance. Then, too, as researchers in lexical development know well, parents are not given to doing the controlled contrastive experiments which can reveal the child's partial appreciation of what is said to him. So long as he gives no unmistakable signs of not comprehending, adults will usually assume the child has processed an utterance fully. Faced with the fact of street urchins, no one likes to contemplate their hunger.

The next and most crucial question is how the child manages to advance linguistically if he is in such a state of deprivation. Three simple suggestions may be put forward here.

First, the very failure of acoustically-based speech processing may impel the child to master other kinds of linguistic information. For instance, whether or not children are biased to use extra-linguistic context in speech perception, the occurrence of quite unintelligible word tokens may encourage the child to look around him for disambiguating clues. Similarly, when adult intelligibility varies with intra-linguistic redundancy, the child will have to cast about for additional information to the precise extent that adults reduce acoustic-phonetic detail. If we can suppose that the child is interested in the language game, that understanding is as important to him as eating to the street-child, we can hypothesize that his resourcefulness will be stimulated by utterances containing forms which he cannot quite recognize, as the urchin might be by the smell of food.

Second, success in language acquisition should breed success in speech recognition. The more the child can learn about the structure of the referent world, about the syntax or the semantics of his language, the more he should be able to overcome the unintelligibility of parental speech. While this process must take at least as long as the process of acquisition itself, it does mean that the low estimated initial intelligibility levels (30%-50%) should soon begin to rise.

Neither of these suggestions explains what we are to do with our input-based theories of language acquisition now that we have serious doubts about the child's perception of that input. Our third suggestion holds that we may retain such theories as can function given only the occasional opportunity for successful perception. In one form or another, many views of acquisition should survive this restriction. Researchers may have been looking for extremely frequent phenomena in parental speech on the assumption that a Law of Exercise governs the child's ability to learn from linguistic input. But large numbers of examples of a rule's use may not be necessary to impress it on the child's memory. What our views need is a proviso that occasional clear cases must be enough to advance language acquisition and that consequently word or rule learning can operate on something close to a single trial.

A similar point is made by Nelson (1981) who puts forward what he calls a 'rare-event cognitive comparison theory'. Given that a full range of linguistic structures are used and given their customary meanings within the input, Nelson claims, a child may learn a new syntactic structure from very few instances. Frequency of occurrence of the structure in adult speech is irrelevant at any stage when the child is unprepared to compare the input examples with his own way of conveying the meaning but it can be relevant when he is ready to make a fruitful comparison. The greater the density of examples at this point, the more likely the child is to hit on the few (1-60, says Nelson) which can enable him to advance his linguistic system. Nelson's presentation begs a number of questions. It is not clear from the description of his studies of the effects of recast sentences that they were the sole cause of the children's progress. Nor is it obvious how he defines the notion of the child's preparedness independently of the fact that the child does learn. Nonetheless, his theory sits easily within the constraints imposed by the present findings.

If very few clear examples of a word or a semantic relationship or a sytactic structure are necessary for learning, the fact that upwards of 50% of the existing examples are unintelligible is not important. Leaving aside the difficult notion of preparedness, this hypothesis implies that the unintelligibility of parental speech handicaps the child only to the extent that he may have to wait some time for crucial examples to occur in a form which he can recognize. Once the necessary scraps appear, the child will snap them up.

It may seem strange to attempt to explain language acquisition as a series of serendipitous encounters between the eager child and the rare usable example. Nonetheless, the explanation comes from a respectable class of theories. Though language acquisition has been characterized by the sort of trial and error learning curve that psychologists associate with the gradual effects of practice, the same curve can be produced by the cumulative effects of single, small flashes of insight. Although it may seem implausible that so complex a skill as language could be developed by an individual via moderately rare fortuitous events, this proposal is quite mundane in comparison with a widely accepted view of the origin of the elements which compose our universe. Bethe and Critchfield (1938) suppose that new elements were gradually created during the nuclear reactions which occur constantly within stars. The accidents whereby the occasional helium atom might be transformed into the next heavier atom, and so forth, are extremely rare, but Bethe and Critchfield are at pains to point out that one single instance suffices to start the procedure. If very rare events occurring over millions of years can create something as complex as the universe, it is not preposterous that moderately rare events occurring over four or five years could account for the development of language.

Footnotes

1. It does not appear to occur when materials are read aloud for use in word- monitoring experiments of the sort Marslen-Wilson and Tyler do. In a class project, my students have found no intelligibility differences for target words excised from Normal prose, Syntactic (i.e. meaningless) prose, and Random Word Order settings modelled directly on the materials in Marslen-Wilson and Tyler (1980). Whether the fault lies in the reader's ability to declimatize the absurdity of the texts or in the limitation of target words to monosyllables is not yet clear. In either case, if normal speech does show the effects of sentential redundancy on word intelligibility and if experimental materials do not, the balance of knowledge sources proposed in the original experiments may not apply to normal speech perception.

2. The issue here is not the sharp onsets and offsets: segmented citation forms are quite recognizable.

BIBLIOGRAPHY

Austerlitz, R. (1956). Gilyak nursery words. *Word, 12*, 270-279.

Avram, A. (1967). De la langue qu'on parle aux enfants roumains. In *To Honor Roman Jakobson*, vol. 1. The Hague: Mouton.

Barclay, J., and Reid, M. (1974). Semantic integration in children's recall of discourse. *DevPsychol, 10*, 277-281.

Bard, E., Anderson, A., and Laver, J. (1982). The intelligibility of speech to children. End of Grant Report, SSRC Project Grant No. HR6130.

Barton, D. (1976). Phonemic discrimination and the knowledge of words in children under 3 years. *PRCLD*, No. 11.

Bellinger, D. (1980). Consistency in the pattern of change in mothers' speech: Some discriminant analyses. *JChL, 7*, 469-487.

Bernstein, B. (1970). A sociolinguistic approach to socialization; with some reference to educability. In F. William (ed.), *Language and poverty: perspectives on a theme*. Chicago: Markham.

Bernstein, B. (1971). *Class, codes and control, I: theoretical studies towards a sociology of language*. London: Routledge and Kegan Paul.

Berry, M. B., and Erickson, R. L. (1973). Speaking rate: effects on children's comprehension of normal speech. *JSHR, 16*, 367-74.

Bethe,H., and Critchfield, C. (1938). The formation of deuterons by proton combination. *PhysRev, 54*, 248-254.

Bever, T. G. (1970). The cognitive basis for linguistic structures. In J. R. Hayes (ed.), *Cognition and the development of language*. New York: Wiley & Sons.

Bhat, D. N. (1967). Lexical suppletion in baby talk. *AnthropolLing*, *9*, 33-36.

Blount, B. G. (1972). Parental speech and language acquisition, some Luo and Samoan examples. *AnthropolLing*, *14*, 119-130.

Blount, B. G. (1977). Ethnography and caretaker-child interaction. In C. E. Snow and C. A. Ferguson (eds.), *Talking to children: language input and acquisition*. Cambridge, England: C. U. P.

Bohannon, J. (1976). Normal and scrambled grammar in discrimination, imitation, and comprehension. *ChDev*, *47*, 669-681.

Bohannon, J. and Marquis, A. (1977). Children's control of adult speech. *ChDev*, *48*, 1002-1008.

Bowerman, M. (1977). The acquisition of word meaning: an investigation of some current conflicts. In P. N. Johnson-Laird and P. C. Wason (eds.), *Thinking*. Cambridge: C. U. P.

Bransford, J., and Franks, J. (1972). The abstraction of linguistic ideas. *Cognition*, *1*, 211-249.

Broen, P. (1972). *The verbal environment of the language-learning child*. ASHA Monograph.

Brown, G., Currie, K., and Kenworthy, J. (1980). *Questions of intonation*. London: Croom Helm.

Brown, R. (1973). *A first language: the early stages*. Cambridge, Ma.: Harvard University Press.

Brown, R. W. (1977). Introduction to C. E. Snow and C. A. Ferguson (eds.), *Talking to children*. Cambridge: C. U. P.

Brown, R. W., and Bellugi, U. (1964). Three processes in the acquisition of syntax. *HER*, *34*, 133-151.

Brown, R. W., Cazden, C. and Bellugi, U. (1968). The child's grammar from I to III. In J. P. Hill (ed.), *Minnesota symposium on child development*, vol. 2. Minneapolis: U. of Minnesota Press.

Brown, R. W., and Fraser, C. (1963). The acquisition of syntax. In C. N. Cofer and B. S. Musgrave (eds.), *Verbal behavior and learning*. New York: McGraw-Hill.

Brown, R., and Hanlon, C. (1970). Derivational complexity and order of acquisition in child speech. In J. R. Hayes (ed.), *Cognition and the development of language*. New York: Wiley.

Bullowa, M., Jones, L. G., and Duckert, A. R. (1964). The acquisition of a word. *LangandSpeech*, *7*, 107-111.

Bynon, J. (1968). Berber nursery language. *TransactPhilSoc*, 107-161.

Bynon, J. (1977). The derivational processes relating Berber nursery words to their counterparts in normal inter-adult speech. In C. E. Snow and C. A. Ferguson (eds.), *Talking to children*. Cambridge: C. U. P.

Carey, S. (1978a). Less may never mean 'More'. In R. Campbell and P. T. Smith, (eds.), *Recent advances in the psychology of language: Language development and mother-child interaction*. New York: Plenum.

Carey, S. (1978b). The child as word learner. In M. Halle, J. Bresnan, and G. Miller (eds.), *Linguistic theory and psychological reality*. Cambridge: M. I. T. Press.

Carroll, J., and White, M. (1973a). Word frequency and age of acquisition as determiners of picture-naming latency. *QJEP*, *25*, 85-95.

Carroll, J., and White, M. (1973b). Age of acquisition norms for 220 picturable nouns. *JVLVB*, *12*, 563-576.

Casagrande, J. B. (1948). Comanche baby language. *IJAL*, *14*, 11-14.

Cassar-Pullicino, J. (1957). Nursery vocabulary of the Maltese Archipelago. *Orbis*, *6*, 192-198.

Cazden, C. B. (1965). Environmental assistance to the child's acquisition of grammar. Ph.D. Dissertation, Harvard University.

Cazden, C. B. (1968). Acquisition of noun and verb inflections. *ChDev.*, *39*, 433-448.

Celce-Murcia, M. (1978). The simultaneous acquisition of English and French in a two-year-old child. In E. M. Hatch (ed.), *Second language acquisition: a book of readings*. Rowley, Ma: Newbury House.

Chamberlain, A. F. (1890). Notes on Indian child language. *AmAnthropol*, *3*, 237-241.

Chamberlain, A. F. (1893). Further notes on Indian child language. *AmAnthropol*, July.

Chew, J. J. (1969). The structure of Japanese baby talk. *Journal-Newsletter of Teachers of Japanese*, *6*, 4-17.

Chomsky, N. (1965). *Aspects of the theory of syntax*. Cambridge, Ma.: M.I.T. Press.

Chomsky, N. (1975). *Reflections on language*. Glasgow: Fontana.

Clark, E. (1973). What's in a word? On the child's acquisition of his first language. In J. E. Moore (ed.), *Cognitive development and the acquisition of language*. New York: Academic Press.

Clark, E. (1974). Non-linguistic strategies and the acquisition of word meanings. *Cognition*, *2*, 161-82.

Clark, E. (1980). Here's the top: nonlinguistic strategies in the acquisition of orientational terms. *ChDev*, *51*, 329-38.

Clark, H. (1970). The primitive nature of children's relational concepts. In J. R. Hayes (ed.),

Clark, H. (1973). The language-as-fixed-effect fallacy: a critique of language statistics in psychological research. *JVLVB*, *12*, 335-359.

Clark, H., and Clark, E. (1977). *Psychology and language: an introduction to psycholinguistics*. New York: Harcourt Brace Jovanovich.

Clark, R., Hutcheson, S., and Van Buren, P. (1974). Comprehension and production in language acquisition. *JLing*, *10*, 39-54.

Clark, H., and Lucy, P. (1975). Understanding what is meant from what is said: a study in conversationally conveyed requests. *JVLVB*, *14*, 56-72.

Cohen, J. (1976). Random means random: discussion of Wike and Church's comments. *JVLVB*, *15*, 261-2.

Cohen, J. and Cohen, P. (1975). *Applied multiple regression/correlation analysis for the behavioural sciences*. Hillsdale: Erlbaum.

Cole, R. A. and Jakimik, J. (1980). A model of speech perception. In R. Cole (ed.), *Perception and production of fluent speech*. Hillsdale, N.J.: Erlbaum.

Cole, R. A. and Perfetti, C. A. (1980). Listening for mispronounciations in a children's story: the use of context by children and adults. *JVLVB*, *19*, 297-315.

Coleman, E. B. (1981). An experiment station for reading. In G. Mackinnon and T. Waller (eds.), *Reading research: advances in theory and practice*, (vol. 2). New York: Academic Press.

Cross, T. (1975). Mothers' speech and its association with the rate of linguistic development in young children. Paper presented at the Third International Child Language Symposium, London, September 3-5, 1975.

Cross, T. (1977). Mothers' speech adjustments: the contributions of selected listener variables. In C. Snow and C. Ferguson (eds.), *Talking to children*. Cambridge: Cambridge University Press.

Cross, T. (1979). Mothers' speech adjustments and child language learning: some methodological considerations. *LangSci*, *1*, 3-25.

Curtiss, S. (1977). *Genie: a psycholinguistic study of a modern-day 'wild child'*. New York: Academic Press.

Dale, P. S. (1974). Hesitation in maternal speech. *LangandSpeech*, *17*, 174-181.

Delack, J. B. (1974). Prosodic analysis of infant vocalizations and the ontogenesis of sound-meaning correlations. *PRCLD*, No. 8.

de Villiers, P. and de Villiers, J. (1972). Early judgements of syntactic and semantic acceptability by children. *JPsycholingRes*, *1*, 299-310.

de Villiers, P. and de Villiers, J. (1973). A cross-sectional study of the acquisition of grammatical morphemes in child speech. *JPsycholingRes*, *2*, 267-278.

Dickson, W., and Brown, N. (1979). *BMDP*. Los Angeles: UCLA Press.

Donaldson, M., and Balfour, G. (1968). Less is more: a study of language comprehension in children. *BJ Psychol*, *59*, 461-72.

Donaldson, M., and McGarrigle, J. (1974). Some clues to the nature of semantic development. *JChLang*, *1*, 185-194.

Donaldson, M. and Wales, R. (1970). On the acquisition of some relational terms. In J. Hayes (ed.), *Cognition and the development of language*. New York: Wiley.

Donaldson, M. (1978). *Children's minds*. Glasgow: Fontana.

Drachman, G. (1973a). Baby talk in Greek. *Working papers in linguistics*, *15*, Ohio State University.

Drachman, G. (1973b). Some strategies in the acquisition of phonology. In M. J. Kenstowicz and C. W. Kisseberth (eds.), *Issues in phonological theory*. The Hague: Mouton.

Edwards, M. (1974). Perception and production in child phonology: the testing of four hypotheses. *JChLang*, *1*, 205-219.

Eilers, R., Oller, D. and Ellington, J. (1974). The acquisition of word-meaning for dimensional adjectives: the long and the short of it. *JChLang*, *1*, 195-204.

Elliot, A. (1981). *Child language*. Cambridge: C. U. P.

Entwhistle, D. R. and Frasure, N. (1974). A contradiction resolved: children's processing of syntactic cues. *DevPsych*, *10*, 852-57.

Epstein, A., Giolas, T. and Owens, E. (1968). Familiarity and intelligibility of monosyllabic word lists. *JSHR*, *11*, 435-8.

Erber, N. (1975). Auditory-visual perception of speech. *JSHD*, *40*, 481-92.

Feldman, C. (1971). The effects of various types of adult responses on the syntactic acquisition of two- to three-year-olds. Unpublished paper, U. of Chicago.

Ferguson, C. A. (1956). Arabic Baby Talk. In Morris Halle *et al* (eds.), *For Roman Jackobson*. The Hague: Mouton.

Ferguson, C. A. (1964). Baby talk in six languages. *AmAnthropol*, *66*, part 2, 103-114.

Ferguson, C. A. (1977). Baby talk as a simplified register. In Snow and Ferguson.

Ferguson, C. and Farwell, C. (1975). Words and sounds in early language acquisition. *Language*, *51*, 419-439.

Fischer, J. L. (1970). Linguistic socialization: Japan and the United States. In R. Hill and R. Konig (eds.), *Families East and West*. The Hague: Mouton.

Fodor, J. A., Bever, T. G., and Garrett, M. F. (1974). *The psychology of language: an introduction to psycholinguistics and generative grammar*. New York: McGraw-Hill./ Forster, K. and Dickinson, R. (1976). More on the language-as-fixed- effect-fallacy: Monte Carlo estimates of error rates for F_1, F_2, F', and min F'. *JVLVB*, *15*, 135-42.

Friedlander, B. Z., Jacobs, A. C., Davis, B. B. and Wetstone, H. S. (1972). Time sampling analysis of infants' natural language environments in the home. *ChDev*, *43*, 730-740.

Furrow, D., Nelson, K. and Benedict, H. (1979). Mothers' speech to children and syntactic development: some simple relationships. *JChLang*, *6*, 423-42.

Garnica, O. (1974). Some characteristics of prosodic input to young children. Ph.D. Dissertation, Stanford University.

Garnica, O. (1977). Some prosodic and paralinguistic features of speech to young children. In Snow and Ferguson.

Gelman, R. and Shatz, M. (1977). Appropriate speech adjustments: the operation of controversial constraints on talk to two-year-olds. In M. Lewis and L. Rosenblum (eds., *Interaction, conversation and the development of language*. New York: Wiley and Sons.

Gleason, J. B. (1973). Code-switching in children's language. In T. E. Moore (ed.). *Cognitive development and the acquisition of language*. New York: Academic Press.

Gleason, J. B. (1975). Fathers and other strangers: Men's speech to young children. In D. Dato (ed.), *Developmenmtal psycholinguistics: theory and applications*. Georgetown University Round Table on Languages and Linguistics, 1975. Washington: Georgetown University Press.

Greenlee, M. (1980). Learning the phonetic cues to the voiced-voiceless distinction: A comparison of child and adult speech perception. *JChLang*, *7*, 459-68.

Grieve, R., Hoogenraad, R. and Murray, D. (1978). On the young child's use of lexis and syntax in understanding locative instructions. *Cognition*, *5*, 235-50.

Gurman, E. A. (1972). On perception, processing and learning. Unpublished paper, Department of Psychology and Social Relations, Harvard University.

Harkness, S. (1976). Mothers' language. In W. Raffler-Engel and Y. Lebrun (eds., *Baby talk and infant speech*. Lisse, Netherlands: Swets and Zeitlinger.

Harkness, S. (1977). Aspects of social environment and first language acquisition in rural Africa. In Snow and Ferguson.

Heider, E., Cazden, C. and Brown, R. (1968). Social class differences in effectiveness and styles of children's coding ability. Project literacy reports.

Hirsh-Pasek, K. and Treiman, R. (1982). Doggerel: motherese in a new context. *JChLang*, *9*, 229-237.

Holzman, M. (1974). The verbal environment provided by mothers for their very young children. *MPQ*, *20* (1), 31-42.

Horgan, D. and Gullo, D. (1977). Motherese, fatherese, androgynese. Paper presented at 'Toward the Competent Parent: An interdisciplinary conference on parenting' (Atlanta, Georgia, February 21-22, 1977).

Howes, D. (1957). On the relation between the intelligibility and frequency of occurrence of English words. *JAcoustSocAm*, *29*, 296-305.

Huttenlocher, J. (1974). The origins of language comprehension. In R. Solso (ed.), *Theories in Cognitive Psychology*. Potomac, Md: Lawrence Erlbaum Associates.

Huttenlocher, J., and Burk, A. (1976). Why does memory span increase with age? *CognPsych*, *8*, 1-31.

Ingram, D. (1974). Phonological rules in young children. *JChLang*, *1*, 49-64.

Jarvella, R. (1971). Syntactic processing of connected speech. *JVLVB*, *10*, 409-416.

Kary, A. (1981). Motherese without the child. Paper presented to the Child Language Seminar, University of Edinburgh, 6-7 April.

Kaye, K. (1980). Why we don't talk 'baby talk' to babies. *JChLang*, *7*, 489-507.

Kelkar, A. (1964). Marathi baby talk. *Word*, *20*, 40-54.

Keppel, G. (1976) Words as random variables: discussion of Wike and Church's comments. *JVLVB*, *15*, 263-265.

Kucera, H., and Frances, W. (1967). *Computational analysis of present-day American English*. Providence: Brown University Press.

Lachman, R. (1973). Uncertainty effects on time to access the internal lexicon. *JExpPsych*, *99*, 199-208.

Laver, J., Hiller, S., and Hanson, R., (1982). Comparative performance of pitch detection algorithms on dysphonic voices. Proceedings of the IEEE International Conference on Acoustics, Speech, and Signal Processing, Paris, Vol. 1, 192-195.

Leventhal, G. (1973a). Effect of sentence context on word perception. *JExpPsych*, *101*, 318-323.

Leventhal, G. (1973b). The effect of category set on auditory word recognition. *JAuditRes*, *13*, 313-319.

Lewis, M. and Freedle, R. (1973). Mother-infant dyad: the cradle of meaning. In P. Pilner, L. Krames and T. Alloway (eds.), *Communication and affect: language and thought*. New York: Academic Press.

Lieberman, P. (1963). Some effects of semantic and grammatical context on the production and perception of speech. *LangandSpeech*, *6*, 172-5.

Longhurst, T. and Stepanich, L. (1975). Mothers' speech addressed to one-, two- and three-year-old normal children. *ChStudJ*, *5*, 3-11.

Lord, C. (1975). Is talking to a baby more than baby talk? A longitudinal study of the modification of input to young children. Unpublished paper, Harvard University.

MacDonald, J., and McGurk, H. (1978). Visual influences on speech perception processes. *PercPsychophys*, *24*, 253-257.

Maclay, H. and Osgood, C. E. (1959). Hesitation phenomena in spontaneous English speech. *Word*, *15*, 19-44.

McGarr, N. (1981). The effect of context on the intelligibility of hearing and deaf children's speech. *LangandSpeech*, *24*, 255-64.

Macken, M. A. (1976). Permitted complexity in phonological development: one child's acquisition of Spanish cosonants. *Lingua*, *44*, 219-53.

Margulies, M. K. (1979). Male-female differences in speaker intelligibility: normal and hearing impaired listeners. In J. Wolf and D Klatt (eds.), Speech Communication Papers presented at the 97th Meeting of the Acoustical Society of America, Cambridge, Ma., June, 1979.

Marslen-Wilson, W. D. (1973). Linguistic structure and speech shadowing at very short latencies. *Nature*, *244*, 522-3.

Marslen-Wilson, W. D. (1975). Sentence perception as an interactive parallel process. *Science*, *189*, 226-7.

Marslen-Wilson, W., and Tyler, L. K. (1980). The temporal structure of spoken language understanding. *Cognition*, *8*, 1-71.

Marslen-Wilson, W. D. and Welsh, A. (1978). Processing interactions and lexical access during word recognition in continuous speech. *CognPsych*, *10*, 29-63.

Messer, D. (1980). The episodic structure of maternal speech to young children. *JChLang*, *7*, 29-40.

Messer, D. (1981). The identification of names in maternal speech to infants. *JPsycholingRes*, *10*, 69-77.

Miller, G., Heise, G. and Lichten, W. (1951). The intelligibility of speech as a function of the context of the text materials. *JExpPsych*, *41*, 329-35.

Moerk, E. L. (1974). Changes in verbal child-mother interactions with increasing language skills of the child. *JPsycholingRes*, *3*, 101-116.

Moerk, E. L (1976). Processes of language teaching and training in interactions of mother-child dyads. *ChDev*, *47*, 1064-1078.

Moerk, E. L. (1980). Relationships between parental input frequencies hildren's language acquisition: a reanalysis of Brown's data. *JChLang*, *7*, 105-18.

Nelson, K. (1973). *Structure and strategy in learning to talk*. Monographs of the society for research in child development, 38, Nos. 1, 2.

Nelson, K. (1977). The conceptual basis for naming. In J. MacNamara (ed.), *Language, learning and thought*. New York: Academic Press.

Nelson, K. (1981). Toward a rare-event cognitive comparison theory of syntax acquisition. In P. Dale and D. Ingram (eds.), *Child Language – an international perspective*. Baltimore: University Park Press.

Nelson, K. E., Carskaddon, G. and Bonvillian, J. D. (1973). Syntax acquisition: Impact of experimental variation in adult verbal interaction with the child. *ChDev*, *44*, 497-504.

Newport, E. L. (1976). Motherese: the speech of mothers to young children. In N. J. Castellan, D. B. Pisoni, and G. R. Potts (eds.), *Cognitive theory*, vol 2. Hillsdale, N. J.: Lawrence Erlbaum Associates.

Newport, E. and Gleitman, H. (1976). Maternal self-repetition and the child's acquisition of language. Paper presented at the Boston University Conference on Language Development.

Newport, E. L., Gleitman, H. and Gleitman, L. R. (1975). A study of mothers' speech and language acquisition. *PRCLD*, No 10

Newport, E., Gleitman, H. and Gleitman, L. (1977). Mother I'd rather do it myself: some effects and non-effects of maternal speech style. In Snow and Ferguson.

Paivio, A., Yuille, J. C. and Madigan, S. (1968). Concreteness, imagery and meaningfulness values for 925 nouns. *JExpPsych*, *76*, 1-25.

Petretic, P., and Tweney, R. (1977). Does comprehension precede production? The development of children's responses to telegraphic sentences of varying grammatical adequacy. *JChLang*, *4*, 201-209.

Phillips, J. R. (1973). Syntax and vocabulary of mothers' speech to young children: age and sex comparisons. *ChDev.*, *44*, 182-185.

Pickett, J. M. and Pollack, I. (1963). Intelligibility of excerpts from fluent speech: effects of rate of utterance and duration of excerpt. *LangandSpeech*, *6*, 151-164.

Pinker, S. (1981). On the acquisition of grammatical morphemes. *JChLang*, *8*, 477-84.

Pollack, I. and Pickett, J. M. (1963). The intelligibility of excerpts from conversation. *LangandSpeech*, *6*, 165-171.

Pollack, I., Rubenstein, H. and Decker, L. (1959). The intelligibility of known and unknown message sets. *JAcoustSocAm*, *31*, 273-9.

Rebelsky, F. and Hanks, C. (1971). Fathers' verbal interaction with infants in the first three months of life. *ChDev*, *42*, 63-8.

Reddy, D. (1980). Machine models of speech perception. In R.Cole (ed.), *Perception and production fo fluent speech.* Hillsdale, N. J.: Erlbaum.

Remick, H. (1971). The maternal environment of linguistic development. Ph.D. Dissertation, U. of California at Davis.

Remick, H. (1976). Maternal speech to children during language acquisition. *Neurolinguistics*, *5*, 223-233.

Retherford, K., Schwarz, B. and Chapman, R. (1981). Semantic roles and residual grammatical categories in mother and child speech: Who tunes into whom? *JChLang*, *8*, 583-608.

Ringler, N. M. (1973). Mothers' language to their children and to adults over time. Ph.D. dissertation, Case Western University.

Ringler, N., Kennell, J., Jarvella, R., Navojosky, B. and Klaus, M. (1975). Mother-to-child speech at two years: effects of early postnatal contact. *JPediatrics*, *86*, 141-44.

Rondal, J. (1980). Fathers' and mothers' speech in early language development. *JChLang*, *7*, 353-369.

Rosenzweig, M. and Postman, L. (1958). Frequency of usage and the perception of words. *Science*, *127*, 26-36.

Rubenstein, H., Decker, L. and Pollack, I. (1959). Word length and intelligibility. *LangandSpeech*, *2*, 175-178.

Rubenstein, H. and Pollack, I. (1963). Word predictability and intelligibility. *JVLVB*, *2*, 147-58.

Ruke-Dravina, V. (1961). Ns. Lastenhoitajain kielesta. *Virittaja*, *1*, 85-91.

Ruke-Dravina, V. (1977). Modifications of speech addressed to young children in Latvian. In Snow and Ferguson.

Sachs, J. (1977). The adaptive significance of linguistic input to prelinguistic infants. In Snow and Ferguson.

Sachs, J., Brown, R. and Salerno, R. (1976). Adults' speech to children. In W. von Raffler-Engel and Y. Lebrun (eds.), *Baby talk and infant speech*. Lisse: Swets and Zeitlinger.

Sachs, J. and Devin, J. (1976). Young children's use of age-appropriate speech styles in social interaction and role-playing. *JChLang*, *3*, 81-98.

Sachs, J. and Johnson, M. (1976). Language development in a hearing child of deaf parents. In von Raffler-Engel and Lebrun.

Sachs, J. and Truswell, L. (1978). Comprehension of two-word instructions by children in the one-word stage. *JChLang*, *5*, 17-24.

Salus, P. H. and Salus, M. W. (1974). Developmental neurophysiology and phonological acquisition order. *Language*, *50*, 151-160.

Schaerlackens, A. M. (1973). *The two-word sentence in child language development*. The Hague: Mouton.

Schiff, N. (1979). The effect of deviant maternal input on the development of language during the preschool years. *JSHR*, *22*, 581-603.

Scholes, R. J. (1970) On functors and contentives in children's immitations of word strings. *JVLVB*, *9*, 167-70.

Schwarz, R. G. and Leonard, L. B. (1982). Do children pick and choose? An examination of phonological selection and avoidance in early lexical acquisition. *JChLang*, *9,R 319-336*.

Shatz, M. (1978a). Children's comprehension of their mothers' question directives. *JChLang*, *5*, 39-46.

Shatz, M. (1978b). On the development of communicative understandings: an early strategy for interpreting and responding to messages. *CognPsych*, *10*, 271-301.

Shatz, M. and Gelman, R. (1973). *The development of communication skills: modification in the speech of young children as a function of listener*. Monographs of the Society for Research in Child Development, 38, No. 5.

Shatz, M. and Gelman, R. (1977). Beyond syntax: the influence of conversational constraints on speech modifications. In Snow and Ferguson.

Sherrod, K., Crawley, S., Peterson, G. and Bennett, P. (1978). Maternal language to prelinguistic infants: Semantic aspects. *InfantBehavDev*, *1*, 335-345.

Sherrod, K., Friedman, S., Crawley, S., Drake, D. and Devieux, J. (1977). Maternal language to prelinguistic infants: syntactic aspects. *ChDev*, *48*, 1662-5.

Shipley, E., Smith, C. and Gleitman, L. (1969). A study in the acquisition of language: free responses to commands. *Language*, *45*, 322-42.

Shockey, L. and Bond, Z. (1980). Phonological processes in speech addressed to children. *Phonetics*, *37*, 267-274.

Slobin, D. (1966). Grammatical transformations and sentence comprehension in childhood and adulthood. *JVLVB*, *5*, 219-227.

Slobin, D. (1973). Cognitive pre-requisites for the acquisition of grammar. In C. Ferguson and D. Slobin (eds.), *Studies of child language development*. New York: Holt, Rinehart and Winston.

Snow, C. E. (1972). Mothers' speech to children learning language. *ChDev*, *43*, 549-565.

Snow, C. (1977a). Mothers' speech research: from input to interaction. In Snow and Ferguson.

Snow, C. (1977b). The development of conversation between mothers and babies. *JChLang*, *4*, 1-22.

Snow, C. E., Arlman-Rupp, A., Hassing, Y., Jobse, J., Joosten, J. and Vorster, J. (1976). Mothers' speech in three social classes. *JPsycholingRes*, *5*, 1-20.

Snow, C. and Ferguson, C. (1977). *Talking to children*. Cambridge: Cambridge University Press.

Staddon, J. and Simmelhag, V. (1971). The 'superstition' experiment, a reexamination of its implications for the principles of adaptive behavior. *PsychRev*, *78*, 3-43.

Stoneman, Z. and Brody, G. H. (1981). Two's company, three makes a difference: an examination of mothers' and fathers' speech to their young children. *ChDev*, *52*, 705-707.

Strange, W. (1981). The relationship between perception and production of /w/, /r/, and /l/. *JExpChPsych*, *31*, 81-102.

Stratton, P. and Connolly, K. (1973). Discrimination by newborns of the intensity, frequency and temporal characteristics of auditory stimuli. *BJPsych*, *64*, 219-232.

Strohner, H. and Nelson, K. (1974). The young child's development of sentence comprehension: influence of event probability, nonverbal context, syntactic form and strategies. *ChDev*, *45*, 567-76.

Thorndike, E. and Lorge, I. (1944).

The teacher's word book of 30,000 words. New York: Bureau of publications, Columbia University Teachers College.

Tolhurst, G. C. (1957). Effects of duration and articulation changes on intelligibility, word reception and listener preference. *JSHD*, *22*, 328-34.

Townsend, D. and Erb, M. (1975). Children's strategies for interpreting complex comparative questions. *JChLang*, *2*, 271-7.

Traul, G. N. and Black, J. W. (1965). The effect of context on aural perception of words. *JSHR*, *8*, 365-9.

Trehub, S. and Abramovitch, R. (1978). Less is not more: further observations on nonlinguistic strategies. *JExpChPsych*, *25*, 160-7.

Tyler, L. and Marslen-Wilson, W. (1978). Some developmental aspects of sentence processing and memory. *JChLang*, *5*, 113-30.

Tyler, L. and Marslen-Wilson, W. (1981). Language processing in children. *JVLVB*, *20*, 400-416.

Van der Geest, T., Gerstel, R., Appel, R. and Tervoort, B. (1973). *The child's communicative competence*. The Hague: Mouton.

Vasic, V. (undated). Verbal interaction between an elder and a younger child within a micro environment. Unpublished paper, Institute of Linguistics, Novi Sad.

Vihman, M. M. (1981). Phonology and the development of the lexicon: evidence for children's errors. *JChLang*, *8*, 239-264.

Voegelin, C. F. and Robinett, F. M. (1954). Mother language in Hidatsa. *IJAL*, *20*, 65-70.

Von Raffler-Engel, W. and Lebrun, Y. (eds.) (1976). *Baby talk and infant speech*. Lisse: Swetz and Zeitlinger.

Wetstone, H., and Friedlander, B. (1973). The effect of word order on young children's responses to simple questions and commands. *ChDev*, *44*, 734-740.

Wilcox, S. and Palermo, D. (1975). 'In', 'on' and 'under' revisited. *Cognition*, *3*, 245-54.

Wilcox, S. and Palermo, D. (1982). Children's use of lexical and nonlexical information in responding to commands. *JChLang*, *9*, 139-150.

Wills, D. D. (1977). Participant deixis in English baby talk. In Snow and Ferguson.

Winer, B. (1971). *Statistical principles in experimental design*. New York: McGraw-Hill.

Winters, J., Winter, I., and Burger, A. (1978). Confidence in age-of-acquisition estimates and its relationship to children's labelling performance. *BullPsychonomSoc*, *12*, 361-364.

Zipf, G. (1935). *The psycho-biology of language: an introduction to dynamic philology*. Boston: Houghton Mifflin. (Reprinted, 1965, M. I. T. Press)

Appendices

APPENDIX A.1

Informants' Ages, Occupations, and Places of Residence.

Parent	Age	Occupation	Places of Residence until age 20
Father of boy, Gr.i	30	Mechanical Engineer	Edinburgh
Mother of boy, Gr.i	29	Animal Technician/ Housewife	Edinburgh
Father of girl, Gr.i	30	Architect	Netherlands, Israel, Greece, Australia, Indonesia, Germany, Czechoslovakia, Scotland
Mother of girl, Gr.i	34	Contractor/ Housewife	Cheshire, Yorkshire, Bedford, Edinburgh
Father of boy, Gr.ii	30	Stockbroker/Medical Representative	Edinburgh
Mother of boy, Gr.ii	30	Teacher/Housewife	Aberdeen, Fife, Edinburgh
Father of girl, Gr.ii	35	Railwayman/Civil Servant	Dundee, Northumberland, Staffordshire
Mother of girl, Gr.ii	33	Social Worker/ Housewife	Kent, Kirkaldy, Dundee
Father of boy, Gr.iii	36	Town and Country Planner	Wiltshire, Gloucestershire, Cambridge
Mother of boy, Griii	35	Primary Teacher/ Housewife	Northampton, Newcastle, Durham
Father of Girl, Gr.iii	48	Life Assurance Official	Edinburgh
Mother of girl, Gr.iii	35	Television floor manager/Housewife	Shropshire, North Berwick, Edinburgh

APPENDIX A.2
Questionnaire

1. NAME OF CHILD: ______________________________

2. CHILD'S DATE OF BIRTH: ______________________________

3. NAME OF PARENT: ______________________________

4. ADDRESS: ______________________________

5. HOW LONG HAVE YOU LIVED THERE/IN EDINBURGH? ______________________________

6. TELEPHONE: ______________________________

7. OTHER CHILDREN IN FAMILY:

NAME	SEX	AGE

8. PARENT'S DATE OF BIRTH: ______________________________

9. PARENT'S PRESENT OCCUPATION: ______________________________

10. PARENT'S FORMER OCCUPATIONS: ______________________________

____

11. PARENT'S PLACE OF BIRTH: ______________________________

12. OTHER PLACES WHERE PARENT HAS LIVED

TOWN	PERIOD OF RESIDENCE

13. LANGUAGES OTHER THAN ENGLISH SPOKEN IN THE HOME

LANGUAGE	SPEAKER

14. PERSONS WHO SPEND TIME WITH CHILD (ADULTS, OLDER CHILDREN, CHILDREN SAME AGE) (INCLUDE NURSERY TEACHERS)

RELATION	AGE	HRS A WEEK	WITHIN EARSHOT	TALKING	PLAYING

15. DOES YOUR CHILD HAVE ANY OF THESE TOYS OR ANY LIKE THEM AT HOME?

____

____

____

____

2.

16. DO YOU PLAY WITH ANY TOYS WHEN YOU PLAY WITH YOUR CHILD? WHAT DO YOU DO WITH THEM?

17. DOES YOUR CHILD HAVE ANY FAVORITE GAMES THAT HE/SHE LIKES TO PLAY WITH YOU? COULD YOU DESCRIBE THEM?

18. DURING MOST OF THIS INTERVIEW, YOUR JOB IS TO PLAY WITH THESE TOYS WITH YOUR CHILD AND TALK TO HIM NATURALLY AS YOU PLAY. HOW UNUSUAL IS THIS SITUATION FOR YOU - YOU, THE CHILD, AND SOME TOYS WITH NO OTHER CHILDREN, NO T.V. ETC. ?

APPENDIX B.1

Experiments 1 and 2. Words presented in Isolation*

Informant Code	Words from Experiment 1		Words from Experiment 2
	Words to Adult	Words to Child	Words to Adult/Child
i.m.F.	carpet	being	door
	soul	sideways	daft
	use	see	
	keen	seat	
	least	throw	
	almost	shopping	
	diving	people	
	great	did	
	lively	flinging	
	rather	lots	
i.m.M.	giving	nicest	build
	eight	juice	turn
	decided	more	
	mainly	be	
	lot	watch	
	talks	turning	
	every	show	
	whole	heavy	
	boat	these	
	include	tree	
i.f.F.	recognize	making	book
	yes	finish	girl
	week	tell	
	long	work	
	difficulty	crumble	
	she	take	
	primarily	put	
	which	give	
	nature	play	
	time	one	
i.f.M.	hoping	bedroom	piano
	same	about	horrid
	sent	both	
	fact	mane	
	mother	trousers	
	who	try	
	guys	come	
	next	gone	
	spent	down	
	good	inside	

* i = 22-24 months, ii = 28-30 months, iii = 34-36 months: m = male child, f = female child, M = mother, F = father

Informant Code	Words from Experiment 1		Words from Experiment 2
	Words to Adult	Words to Child	Words to Adult/Child
ii.m.F.	America	for	foxed
	say	in	bus
	born	are	
	went	picture	
	vicious	do	
	following	wait	
	done	daddy	
	don't	they	
	as	home	
	high	the	
ii.m.M.	April	that	animals
	teacher	you	bike
	have	what	
	mean	else	
	but	shapes	
	reels	we	
	before	favourite	
	know	dear	
	he	sleep	
	over	got	
ii.f.F.	lived	want	puzzle
	not	there	table
	sixteenth	get	
	idea	while	
	road	again	
	together	shoes	
	mornings	piece	
	English	look	
	to	front	
	comes	colour	
iii.f.M.	all	round	sit
	bother	top	work
	plus	something	
	sure	find	
	easier	lady's	
	other	read	
	sort	handle	
	any	ones	
	only	right	
	bit	is	
iii.m.F.	country	goes	wheels
	used	load	parked
	service	can't	
	conversation	slowly	
	once	shall	
	during	now	
	are	mummy	
	occasional	could	
	my	let's	
	Edinburgh	stop	

Informant Code	Words from Experiment 1 Words to Adult	 Words to Child	Words from Experiment 2 Words to Adult/Child
iii.m.M.	years every and track each variety nonstop bout related weekends	called mind out going takes hard make post them does	jigsaw doll
iii.f.F.	just way most navy packing name stories sees reading enough	lock will big back hanging screw record unlock patio force	quick short
iii.f.M.	seventy age two hope saucers tends commuting area erase been	with stairs box should fits green needs think matched gates	open different

APPENDIX B.2

Experiment 1. Mean Difference Scores (Correct Words to Adult - Correct Words to Child) per Five Word Cell and Associated F-ratios.

Effect	Word Group	Speakers	Addressee Difference	F_1	F_2	Min F′
1. Mean	A	All	.579	107.37	6.24	5.89
				(1,19)	(1,48)	(1,53)
				p<.0001	p=.012	p<.025
	B	All	1.108	133.85	4.85	16.21
				(1,19)	(1,48)	(1,59)
				p<.0001	p=.0001	p<.001
2. Child Age	A	Parents in Gr i	.038	65.06	5.82	
		Parents in Gr ii	-.113	(2,38)	(2,48)	
		Parents in Gr iii	1.813	p<.0001	p=.0055	p<.01
	B	Parents in Gr i	.863	22.85	3.39	
		Parents in Gr ii	1.900	(2,38)	(2,48)	
		Parents in Gr iii	.563	p<.001	p=.0418	n.s.
3. Child Sex	A	Parents of Boys	.983	20.76		
		Parents of Girls	.175	(1,19)		
	B	Parents of Boys	1.100			
		Parents of Girls	1.117	n.s.	n.s.	
4. Parent Sex	A	Fathers	.833	15.31		
		Mothers	.325	(1,19)		
				p=.009	n.s.	
	B	Fathers	1.675	38.26	5.79	
		Mothers	.542	(1,19)	(1,48)	
				p<.0001	p=.02	p<.05

APPENDIX B.2 (cont'd)

Effect	Word Group	Speakers	Addressee Difference	F_1	F_2	Min F′
5. Child Age x Parent Sex	A	Fathers in Gr i	.675	7.65		
		Mothers in Gr i	-.600	(2,38)		
		Fathers in Gr ii	-.200	p=.0016	n.s.	
		Mothers in Gr ii	-.025			
		Fathers in Gr iii	2.025			
		Mothers in Gr iii	1.600			
	B	Fathers in Gr i	1.825	6.09		
		Mothers in Gr i	-.100	(2,38)		
		Fathers in Gr ii	2.500	p=.0051	n.s.	
		Mothers in Gr ii	1.300			
		Fathers in Gr iii	.700			
		Mothers in Gr iii	.425			
6. Child Age x Child Sex	A	Parents of Boys in Gr i	.125	12.48		
		Parents of Girls in Gr i	-.050	(2,38)		
		Parents of Boys in Gr ii	.150	$p<.0001$	n.s.	
		Parents of Girls in Gr ii	-.375			
		Parents of Boys in Gr iii	2.675			
		Parents of Girls in Gr iii	.950			
	B	Parents of Boys in Gr i	.475	14.59	2.54	
		Parents of Girls in Gr i	1.250	(2,38)	(2,48)	
		Parents of Boys in Gr ii	1.550	$p<.0001$	$.10>p>.05$	
		Parents of Girls in Gr ii	2.250			
		Parents of Boys in Gr iii	1.275			
		Parents of Girls in Gr iii	-.150			
7. Parent Sex x Child Sex	A	Fathers of Boys	.517	81.57	6.38	5.92
		Fathers of Girls	1.150	(1,19)	(1,48)	(1,55)
		Mothers of Boys	1.450	$p<.0001$	p=.015	$p<.025$
		Mothers of Girls	-.800			

APPENDIX B.2 (cont'd)

Effect	Word Group	Speakers	Addressee Difference	F_1	F_2	MinF′
7. Parent Sex x Child Sex	B	Fathers of Boys	1.533			
		Fathers of Girls	1.817			
		Mothers of Boys	.667			
		Mothers of Girls	.417	n.s.	n.s.	
8. Child Sex x Parent Sex x Child Age	A	Boy's Father, Gr i	-.300	13.70		
		Boy's Mother, Gr i	1.600	$(2,38)$		
		Girl's Father, Gr i	.550	$p<.0001$	n.s.	
		Girl's Mother, Gr i	-1.650			
		Boy's Father, Gr ii	-.100			
		Boy's Mother, Gr ii	-.200			
		Girl's Father, Gr ii	.400			
		Girl's Mother, Gr ii	-.550			
		Boy's Father, Gr iii	2.050			
		Boy's Mother, Gr iii	1.900			
		Girl's Father, Gr iii	3.300			
		Girl's Mother, Gr iii	.000			
	B	Boy's Father, Gr i	.900	8.86		
		Boy's Mother, Gr i	2.650	$(2,38)$		
		Girl's Father, Gr i	.050	$p=.0007$	n.s.	
		Girl's Mother, Gr i	-.250			
		Boy's Father, Gr ii	1.700			
		Boy's Mother, Gr ii	2.900			
		Girl's Father, Gr ii	1.250			
		Girl's Mother, Gr ii	1.550			
		Boy's Father, Gr iii	1.850			
		Boy's Mother, Gr iii	-.350			
		Girl's Father, Gr iii	.600			
		Girl's Mother, Gr iii	.150			

APPENDIX B.3

Experiments 3 and 4. Sentences Presented With or Without Stimulus Words.

Group A.

Speaker and Addressee Code**		Sentence
i.m.F.	A	We fight each other on the (CARPET)*
	A	He's not all that (KEEN) on sitting and playing with toys.
	C	She's away getting the (SHOPPING).*
	C	There's (LOTS) of toys here.
ii.m.M.	A	I suppose that would (INCLUDE) neighbours.
	A	I wouldn't say he (TALKS) to them.*
	C	Is that the (NICEST) one? *
	C	(WATCH) where you're going.
i. f.F.	A	(SHE) comes from Devon*
	A	A great deal of the (TIME) because I'm working from home at the moment.
	C	What am I (MAKING)? *
	C	What does (CRUMBLE) have for for lunch.
i.f.M.	A	But I'm (HOPING) to go back in about January.*
	A	His (MOTHER) is actually Scottish.
	C	(TRY) another piece, that's too big.*
	C	And what has it got (INSIDE) it.
ii.m.F	A	I don't know if you've been (FOLLOWING) it in the paper, I mean (I think that)
	A	He's (HIGH) as a kite from this afternoon
	C	Douglas, come and sit on my knee (FOR) a minute, will you.*
	C	And what do you (DO) with the big bricks.
ii.m.M.	A	Our daughter was born on the 17th of (APRIL) *
	A	Well I suppose his grandparents (BUT) they are not regular.
	C	Ah, there (WE) are.*
	C	Come and show me what you've (GOT) then.
ii.f.F.	A	I (LIVED) in Dundee.*
	A	Her auntie lives along the (ROAD).
	C	Your (SHOES) are on Squeaker.*
	C	Is this the (COLOUR).
ii.f.M.	A	More hours than I am the (OTHER).*
	A	Its a (BIT) of both really.
	C	Turn the house (ROUND) till you find the green door.*
	C	Are you in the (LADY'S) chair now.
iii.m.F.	A	I've always been in town and (COUNTRY) planning, yes.*
	A	Um he goes to playgroup (ONCE) a week.
	C	The lady's finished talking (NOW).*
	C	Made him (STOP) has it.
iii.m.M.	A	Um, its a much bigger (VARIETY) than that.*
	A	Well they have long (WEEKENDS)
	C	What did we say that one was (CALLED).*
	C	Who (TAKES) you up the stairs?

Group A continued.

Speaker and Addressee Code **		Sentence
iii.f.F.	A	I don't know just a (NAME) she invented which is rather nice.*
	A	Fortnight holiday is not (ENOUGH).
	C	Do you want to (LOCK) the door?*
	C	She's (HANGING) the washing out.
iii.f.M.	A	Now Gran Gran lives with us on a sort of (SEVENTY) five per cent basis.*
	A	Cups and (SAUCERS) we dont have actually.
	C	So you would need the dark (GREEN) door.*
	C	What do you think the (GATES) are for?

(Matched words from Experiment 2)

i.m.F.	A	It seems a bit (DAFT).*
	C	Shut the (DOOR).*
i.m.M.	A	You have to (TURN) the handle.*
	C	I havent seen you (BUILD) this wonderful house.*
i.f.F.	A	And upstairs the dentist (GIRL) and her husband*
	C	Do you want to look at your (BOOK)?
i.f.M.	A	And she's very interested in the (PIANO).*
	C	What's (HORRID)?*
ii.m.F	A	Well he hasn't been in a (BUS) for a long time.*
	C	Youre good at doing that one but I think this one will have you (FOXED) slightly.
ii.m.F	A	And he's got farm (ANIMALS).*
	C	Has he got a car or a (BIKE) down there.*
ii.f.F.	A	Ah she wants to play with the (PUZZLE).*
	C	On the kitchen (TABLE), squeaker.*
ii.f.M.	A	I can never (WORK) these out for myself.*
	C	Did you (SIT) there when you did it, did you.*
iii.m.F.	A	He's fanatical on (WHEELS).*
	C	Is he (PARKED) there is he. *
iii.m.M.	A	I havent seen him playing with a (DOLL) before.*
	C	What about the (JIGSAW).*
iii.f.F.	A	There's a story about a (SNORT) and a baby bird*
	C	I dont think I could do it as (QUICK) as you.
iii.f.M.	A	Does the lego box (OPEN)? *
	C	Am, I think they're (DIFFERENT) sizes.

* Sentences used in Experiment 4.

** i, ii, iii = Child Age: m, f = male, female child:
M.F. = Mother, Father: A= addressed to an adult,
C = addressed to a child

Group B.

Speaker and Addressee Code		Sentence
i.m.F.	A	He sees them off and on (ALMOST) every day.
	A	He'd (RATHER) be out digging holes in the garden and things like that.*
	C	He's sitting in his little (SEAT) in the car.*
	C	Well what did you (THROW) it away for.
i.m.M.	A	Injecting them and (GIVING) them by mouth.*
	A	He gets a (LOT) of company.
	C	You're (TURNING) it on.*
	C	I can see a (TREE).
i.f.F.	A	Probably (RECOGNIZE) what I'm making.*
	A	I think I'd have a certain amount of (DIFFICULTY) doing this myself, I think.
	C	Shall I (TAKE) that off for you.*
	C	That's another (ONE) open.
i f.M.	A	That's Crumble (WHO) is our cat.*
	A	So it was quite (GOOD).
	C	The piano is in your (BEDROOM) isn't it.*
	C	There's an elephant on your (TROUSERS).
ii.m.F.	A	I did P.R. in South (AMERICA).*
	A	(VICIOUS) streak coming out obviously.
	C	Now (WAIT) a minute.*
	C	All (THE) bits are here.
ii.m.M.	A	He's got a box of those Galt (REELS) that you thread on.*
	A	But (OVER) the day perhaps be about half an hour.
	C	She's enjoying (THAT).*
	C	Going to take the (SHAPES) out?
ii.f.F.	A	We all eat (TOGETHER).*
	A	The other child (COMES) to see her aunt.
	C	Do you (WANT) to sit in there.*
	C	You gonna lock it (AGAIN).
ii.f.M.	A	Um, specifically her rather than with them (ALL).*
	A	I'm sure thats much (EASIER) than some people's record.
	C	What book does Mummy (READ) you before you go to sleep.*
	C	(IS) that the right way?
iii.m.F.	A	I would say 10 hours (DURING) Monday to Friday, perhaps 2 hours in the evening.*
	A	Um we have no relatives in (EDINBURGH).
	C	Do you think that (GOES) like that. *
	C	(SHALL) we build a tower now with the other bits.
iii.m.M.	A	Then it was Durham for three (YEARS).*
	A	They are not just with (EACH) other.
	C	The other one was (HARD).*
	C	What (DOES) it look like.

Group B. continued.

Speaker and Addressee Code		Sentence
iii.f.F.	A	I dont know (JUST) how many.*
	A	But mostly (PACKING) breakfast in.
	C	We can (SCREW) them on and unscrew them.
	C	No dont (FORCE) it Katie.*
iii.f.M.	A	Her dolls she (TENDS) to pull to bits.*
	A	It hasn't (BEEN) opened actually.
	C	Yes but before you play (WITH) the lego I think you should put some of the other things back together.*
	C	That (FITS) in the roof.

(Matched words from Experiment 2)

i.m.F.	C	Youre (DAFT).*
	A	He's got a (DOOR) fixation.*
i.m.M.	C	(TURN) the key.*
	A	We (BUILD) a tower.*
i.f.F.	C	That's a little (GIRL) playing with it, isn't it.*
	A	I should have brought Richard Skarry's (BOOK).*
i.f.M.	C	You like the (PIANO).*
	A	That's what she does when things are (HORRID).*
ii.m.F.	C	See there's the driver in the (BUS). *
	A	I think its going to have me (FOXED) as well.*
ii.m.M.	C	I see (ANIMALS) in that box.*
	A	Then of course the big toys that he plays with by himself the sc- (BIKE).*
ii.f.F.	C	That's a (PUZZLE).*
	A	She'll even draw on the (TABLE).*
ii.f.M.	C	Will that (WORK) in that one?.*
	A	Probably (SIT) down with her say.*
iii.m.F.	C	Can you make something with (WHEELS) on?.*
	A	You know I have to look after one line of (PARKED) cars*
iii.m.M.	C	That's a (DOLL).*
	A	Uh and he has this (JIGSAW).*
iii.f.F.	C	The one with the (SNORT).*
	A	How (QUICK) was she on the the first time?*
iii.f.M.	C	Can you (OPEN) all the other doors?*
	A	At this angle the colours dont look much (DIFFERENT).*

*Sentences used in Experiment 4.

APPENDIX C.

Experiment 6. (Child Pilot, Matched Words).
Stimuli, Sources, and Design.

Group: ONE

Order	Corpus Code	Original Addressee	Word
1.		(cit.)	saucer
2.		(cit.)	basket
3.	ii.f.F.	Child	table
4.	iii.m.F.	Adult	wheels
5.	ii.m.M.	Child	bike
6.	iii.f.F.	Adult	box
7.	i.m.F.	Adult	door
8.	ii.f.M.	Child	bricks
9.	i.f.M.	Adult	cat
10.	iii.m.M.	Child	jigsaw

Group: TWO

Order	Corpus Code	Original Addressee	Word
1.		(cit.)	saucer
2.		(cit.)	basket
3.	i.f.F.	Adult	book
4.	iii.f.M.	Child	keys
5.	i.m.M.	Adult	car
6.	ii.m.F.	Child	bus
7.	ii.f.F.	Adult	table
8.	iii.m.F.	Child	wheels
9.	ii.m.M.	Adult	bike
10.	iii.f.M.	Child	box

Group: THREE

Order	Corpus Code	Original Addressee	Word
1.		(cit.)	saucer
2.		(cit.)	basket
3.	i.m.F.	Child	door
4.	ii.f.M.	Adult	bricks
5.	i.f.M.	Child	cat
6.	iii.m.M.	Adult	jigsaw
7.	i.f.F.	Child	book
8.	ii.f.M.	Adult	keys
9.	i.m.M.	Child	car
10.	ii.m.F.	Adult	bus

APPENDIX D.1

Experiment 7. (Child and Adult Subjects): Source Sentences, Stimulus Sets and Presentation Groups for All Conversational Stimuli*.

Corpus Tape Code*	Original Addressee	Stimulus Set**	Source (STIMULUS)
Group I			
iii.m.F.	Adult	mq	He's fanatical on WHEELS
iii.m.F.	Child	mq	Can you make something with WHEELS on?
ii.f.M.	Adult	mq	I sometimes build BRICKS, I think, or ...
ii.f.M.	Child	mq	How many BRICKS have you put on?
i.f.F.	Adult	mq	I should have brought Richard Skarry's BOOK
i.f.F.	Child	mq	Do you want to look at your BOOK?
iii.f.M.	Adult	nr	Cups and SAUCERS we don't have, actually
iii.f.M.	Child	nr	What do you think the GATES are for?
ii.m.F.	Adult	nr	Must be the same manufacturer because the saucers are the same, the CUPS are a slightly different design.
ii.m.F.	Child	nr	What's the PICTURE at home?
i.m.M.	Adult	nr	It's a BALL shape with lots of shapes
i.m.M.	Child	nr	I can see a TREE.
(Group I also included Citation forms of words in mx, mw, nw)			
Group II			
iii.f.M.	Adult	mr	Does the Lego BOX open?
iii.f.M.	Child	mr	You're popping them in the BOX, are you?
ii.m.F.	Adult	mr	Well, he hasn't been on a BUS for a long time ...
ii.m.F.	Child	mr	See, there's the driver in the BUS
i.m.M.	Adult	mr	Or, or we have a cupboard with louvre DOORS
i.m.M.	Child	mr	Let's get the DOORS shut
iii.m.F.	Adult	nq	He has a BUCKET but not a basket
iii.m.F.	Child	nq	A, a... TAXI car

/continued

Corpus Tape Code*	Original Addressee	Stimulus Set**	Source (STIMULUS)
Group II (continued)			
ii.f.M.	Adult	nq	She'll have baskets, you know, from shopping, little shopping BAG
ii.f.M.	Child	nq	That's like the WALL that Humpty Dumpty fell off, isn't it?
i.f.F.	Adult	nq	Um, downstairs neighbor - she's a NURSE
i.f.F.	Child	nq	That's where Daddy hit his finger with a HAMMER.

(Group II also included Citation forms of words in mw, mx, nx.)

Corpus Tape Code*	Original Addressee	Stimulus Set**	Source (STIMULUS)
Group III			
iii.m.M.	Adult	ms	I haven't seen him playing with a DOLL before
iii.m.M.	Child	ms	That's a DOLL
ii.m.M.	Adult	ms	She wants to play with the PUZZLE
ii.f.F.	Child	ms	That's a PUZZLE
i.f.M.	Adult	ms	Maybe that is another LION
i.f.M.	Child	ms	Well, it's a LION
iii.f.F.	Adult	nt	She says 'no!' and disappears under the, under the CUSHION
iii.f.F.	Child	nt	We can SCREW them on and unscrew them
ii.m.M.	Adult	nt	Play with CARDS, etc., sometimes, you know, just ...
ii.m.M.	Child	nt	It's a big BEAR, isn't it?
i.m.F.	Adult	nt	He'd rather be out digging holes in the GARDEN

/continued

Corpus Tape Code*	Original Addressee	Stimulus Set**	Source (STIMULUS)
Group III (continued)			
i.m.F.	Child	nt	It's a TIGER
(Group III also included Citation forms of words in mu, mv, nu.)			
Group IV			
iii.f.F.	Adult	mt	Cause she comes down afterwards, just as I'm going out the DOOR, she stops me.
iii.f.F.	Child	mt	Are you going to lock the DOOR now?
ii.m.M.	Adult	mt	The big toys he plays with himself, the sc... BIKE!
ii.m.M.	Child	mt	Has he got a car or a BIKE down there?
i.m.F.	Adult	mt	It's Paddington SOCKS
i.m.F.	Child	mt	These are your Paddington SOCKS
iii.m.M.	Adult	ns	I, um, build with the BRICKS
iii.m.M.	Child	ns	You get out the CHAIR then
ii.f.F.	Adult	ns	Then occasionally you can take the kind of BLOCK of a whole day out of that
ii.f.F.	Child	ns	Your SHOES are on, Squeaker
i.f.M.	Adult	ns	And she's very interested in the PIANO
i.f.M.	Child	ns	There's an ELEPHANT on your trousers.
(Group IV also included Citation forms of words in mu, mv, nv.)			
Group V			
iii.m.M.	Adult	mu	If you're in a council HOUSE, you know, you can't move very easily
iii.m.M.	Child	mu	I think it's some kind of HOUSE, isn't it?

/continued

Corpus Tape Code*	Original Addressee	Stimulus Set**	Source (STIMULUS)
Group V (continued)			
ii.f.M.	Adult	mu	It's often, say, quarter to eight by the time she's in BED
ii.f.M.	Child	mu	What book do you take to BED?
i.f.F.	Adult	mu	Yes, occasionally with BLOCKS and things of that nature
i.f.F.	Child	mu	Those BLOCKS just like yours
iii.f.M.	Adult	nv	This is Blue DOG
iii.f.M.	Child	nv	That's another WINDOW
ii.m.F.	Adult	nv	And a TEAPOT
ii.m.F.	Child	nv	It's got DUCKS, hasn't it?
i.m.M.	Adult	nv	He likes playing with MONEY
i.m.M.	Child	nv	There's a BOAT
(Group V also included Citation forms of words in mt, ms, ns.)			
Group VI			
iii.m.M.	Adult	mv	And if she then discovers that she has mastered the art of unlocking with KEYS...
iii.m.M.	Child	mv	Pick up the bunch of KEYS and put them there.
ii.m.F.	Adult	mv	I don't know if you've been following it in the PAPER
ii.m.F.	Child	mv	You can see through the PAPER
i.m.M.	Adult	mv	I mean, he was just screaming all the way home in the CAR
i.m.M.	Child	mv	Put the lady in the CAR
iii.m.F.	Adult	nu	Well, he has, um...not dolls but a TEDDY, you know
iii.m.F.	Child	nu	Now WATCH

/continued

Corpus Tape Code*	Original Addressee	Stimulus Set**	Source (STIMULUS)
Group VI (continued)			
ii.f.M.	Adult	nu	Although she doesn't actually DRESS herself yet
ii.f.M.	Child	nu	What colour's your JUMPER?
i.f.F.	Adult	nu	Mind if we give her some ORANGE juice?
i.f.F.	Child	nu	She's wearing PANTS, is she?
(Group VI also included Citation forms of words in ms, mt, nt.)			
Group VII			
iii.m.M.	Adult	mw	Uh, and he has this JIGSAW
iii.m.M.	Child	mw	What about the JIGSAW?
ii.f.F.	Adult	mw	She'll even draw on the TABLE
ii.f.F.	Child	mw	On the kitchen TABLE
i.f.M.	Adult	mw	That's Crumble, who is our CAT
i.f.M.	Child	mw	And the CAT lives in the barn
iii.f.F.	Adult	nx	There's a story about a snort and a baby BIRD
iii.f.F.	Child	nx	I don't think he's a MONKEY, actually
ii.m.M.	Adult	nx	I see it, a little BASKET down there
ii.m.M.	Child	nx	A ZEBRA
i.m.F.	Adult	nx	We fight each other on the CARPET
i.m.F.	Child	nx	It's a fancy FLOWER.
(Group VII also included Citation forms of words in mr, mq, nq.)			

/continued

Corpus Tape Code*	Original Addressee	Stimulus Set**	Source (STIMULUS)
Group VIII			
iii.f.F.	Adult	mx	Well, that's the BOX for the...
iii.f.F.	Child	mx	Put them back in the BOX and play with something else
ii.m.M.	Adult	mx	He's paddling about in the BATH, but that's about it
ii.m.M.	Child	mx	You could use this for a BATH
i.m.F.	Adult	mx	He's got a DOOR fixation
i.m.F.	Child	mx	Shut the DOOR
iii.m.M.	Adult	nw	Watering all the PLANTS or the step
iii.m.M.	Child	nw	An ELEPHANT, yes
ii.f.F.	Adult	nw	She often does to bed about eight o'CLOCK, half past eight
ii.f.F.	Child	nw	That's your SOCKS
i.f.M.	Adult	nw	She's absolutely mad about HENS
i.f.M.	Child	nw	It's a COW

(Group VIII also included Citation forms of words in mq, nr, mr.)

*i, ii, iii = Child Age; m,f = male, female child; M,F = Mother, Father
**m = matched; n = nonmatched

APPENDIX D.2

Experiment 7. The Structure of the Two Tapes in a Typical Group.

Tape	First Half: Stimuli	Second Half: Stimuli
A:	citation mx_1	citation nx_1 (--> A)
	citation mx_2	citation nx_2 (--> A)
	conversational mr_1 --> adult	conversational mr_1 --> child
	conversational mr_2 --> adult	conversational mr_2 --> child
	conversational mr_3 --> adult	conversational mr_3 --> child
	conversational nq_1 --> child	conversational nq_1 --> adult
	conversational nq_2 --> child	conversational nq_2 --> adult
	conversational nq_3 --> child	conversational nq_3 --> adult
	citation mx_3	citation nx_1 (--> child)
B:	citation nx_2 (--> adult)	citation mx_1
	citation nx_3 (--> child)	citation mx_2
	conversational mr_1 --> child	conversational mr_1 --> adult
	conversational mr_2 --> child	conversational mr_2 --> adult
	conversational mr_3 --> child	conversational mr_3 --> adult
	conversational nq_1 --> adult	conversational nq_1 --> child
	conversational nq_2 --> adult	conversational nq_2 --> child
	conversational nq_3 --> adult	conversational nq_3 --> child
	citation nx_3 (--> adult)	citation mx_3

APPENDIX D.3

Experiment 7. Treatment Conditions for Child and Adult Subjects.

a. Child Subjects

GROUP	CONDITION	SESSION 1			SESSION 2		
		Tape	Context		Tape	Context	
			1st ½	2nd ½		1st ½	2nd ½
(any)	a	A	Vis	Hid	B	Vis	Hid
	b	B	Hid	Vis	A	Hid	Vis
	c	B	Vis	Hid	B	Hid	Vis
	d	A	Hid	Vis	A	Vis	Hid

b. Adult Subjects

GROUP	CONDITION	Tape	1st ½	2nd ½	Tape	1st ½	2nd ½
I, II, V, VI	a	A	Vis	Hid	B	Vis	Hid
III, IV, VII, VIII	b	B	Hid	Vis	A	Hid	Vis

APPENDIX D.4

Experiment 7: Principal Results of Overall ANOVAs on Conversational Forms.

a. Child Subjects, Matched Words

Effect	Cell Means (out of 3 words)	F_1	F_2	Min F′
1. Addressee	Adult: 1.227 Child: 1.117	2.35 n.s.	< 1	
2. Context	Hidden : 1.117 Visible: 1.227	2.21 n.s.	2.88 (1,32) p .10	
3. Order	Session 1: 1.063 Session 2: 1.281	11.65 (1,24) $p < .005$	8.71 (1,32) $p = .0059$	4.98 (1,80) $p < .05$
4. Group	I:1.125 V: .813 II:1.469 VI:1.125 III: .469 VII:1.813 IV:1.500 VIII:1.063	4.27 (1,24) $p < .005$	1.39 n.s.	
5. Group x Addressee	Adult / Child I 1.438 / .813 II 1.563 / 1.375 III .375 / .563 IV 1.563 / 1.438 V .563 / 1.063 VI 1.500 / .750 VII 1.938 / 1.688 VIII .875 / 1.250	4.90 (7,24) $p < .005$	< 1	
6. Order x Addressee x Context	Adult: Hidden / Visible Sess.1 1.188 / 1.156 Sess.2 1.063 / 1.500 Child: Sess.1 .813 / 1.094 Sess.2 1.406 / 1.156	3.30 (1,24) $p < .10$	6.48 (1,32) $p = .0159$	

APPENDIX D.4 (cont'd)

b. Child Subjects, Nonmatched Words

Effect	Cell Means	F_1	F_2	Min F′
1. Addressee	Adult: 1.266 Child: 1.563	6.68 (1,24) $p<.025$	<1	
2. Context	Hidden : 1.359 Visible: 1.469	3.59 (1,24) $p<.10$	2.35 n.s.	
3. Order	Session 1: 1.305 Session 2: 1.523	12.00 (1,24) $p<.005$	10.72 (1,32) $p=.0025$	5.66 (1,78) $p<.025$
4. Group	I. .906 V. 2.125 II. 1.844 VI. 1.875 III. 1.375 VII. 1.031 IV. 1.344 VIII. .813	10.81 (7,24) $p<.005$	1.27 n.s.	

c. Adult Subjects, Matched Words

Effect	Cell Means	F_1	F_2	Min F′
1. Addressee	Adult: 2.300 Child: 2.500	5.63 (1,16) $p<.05$	<1	
2. Context	Hidden : 2.400 Visible: 2.400		1.88 n.s.	
3. Order	Session 1: 2.362 Session 2: 2.437	1.67 n.s.	3.93 (1,16) $p<.10$	
4. Group	I. 2.250 III. 2.725 II. 2.300 IV. 2.325	2.63 (3,16) $p<.10$	<1	

APPENDIX D.4 (cont'd)

c. Adult Subjects, Matched Words (continued)

Effect	Cell Means (out of 3 words)	F_1	F_2	Min F′
5. Order x Context x Addressee	Adult: Hidden / Visible Sess.1 2.150 2.300 Sess.2 2.550 2.200 Child: Hidden / Visible Sess.1 2.550 2.450 Sess.2 2.350 2.650	4.236 (1,16) $p < .10$	1	
6. Group x Order x Context	Sess. 1 Hid / Vis; Sess.2 Hid / Vis I. 2.100 2.300 2.200 2.400 II. 2.200 2.400 2.600 2.000 III. 2.700 2.600 2.700 2.900 IV. 2.400 2.200 2.300 2.400	3.66 (3,16) $p < .05$	1	
7. Group x Order x Context x Addressee		10.33 (3,16) $p < .05$	1.26 n.s.	

d. Adult Subjects, Nonmatched Words

Effect	Cell Means (out of 3 words)	F_1	F_2	Min F′
1. Addressee	Adult: 2.475 Child: 2.675	12.20 (1,16) $p < .005$	1	
2. Context	Hidden : 2.525 Visible: 2.625	4.27 (1,16) $p < .10$	1.69 n.s.	
3. Order	Session 1: 2.475 Session 2: 2.675	11.64 (1,16) $p < .005$	4.17 (1,16) $p = .0579$	

APPENDIX D.4 (cont'd)

d. Adult Subjects, Nonmatched Words (continued)

Effect	Cell Means (out of 3 words)			F_1	F_2	Min F′
4. Group		I. 2.450	III. 2.500	2.49	1	
		II. 2.800	IV. 2.500	(3,16)		
				$p < .10$		
5. Order x Context		Hidden	Visible	13.80	1.27	
	Sess.1:	2.550	2.400	(1,16)	n.s.	
	Sess.2:	2.500	2.850	$p < .005$		
6. Context x Addressee	Adult	2.475	2.475	4.57	2.79	
	Child	2.575	2.775	(1,16)	n.s.	
				$p < .05$		
7. Order x Context x Addressee		Adult				
		Hidden	Visible	8.52	1.76	
	Sess.1:	2.700	2.100	(1,16)	n.s.	
	Sess.2:	2.250	2.850	$p = .01$		
		Child				
	Sess.1:	2.400	2.700			
	Sess.2:	2.750	2.850			
8. Group x Addressee		A				
8. Group x Addressee		Adult	Child	9.65	1.29	
	I	2.350	2.550	(3,16)	n.s.	
	II	2.950	2.650	$p < .005$		
	III	2.300	2.800			
	IV	2.300	2.700			
9. Group x Context		Hidden	Visible	5.69	1	
	I	2.300	2.600	(3,16)	n.s.	
	II	2.850	2.750	$p < .01$		
	III	2.600	2.500			
	IV	2.350	2.650			
10. Group x Order x Context x Addressee				4.00	1.40	
				(3,16)	n.s.	
				$p < .05$		

APPENDIX D.5

Experiment 7. Cell Means and Associated F-values for Principal Effects in the First Presentation of Words to Child Subjects - All Data.

a. Nonmatched Words

Effect	Cell Means		F_1	F_2	Min F′
1. Addressee	To Adult: 1.109 To Child: 1.500		9.52 (1,24) p<.01	n.s.	
2. Context	Hidden: 1.188 Visible: 1.422		5.25 (1,24) p<.05	4.89 (1,32) p=.034	n.s.
3. Group	1: .875 2: 1.688 3: 1.250 4: 1.313	5: 1.938 6: 1.750 7: 0.875 8: 0.750	7.068 (7,24) p<.005	n.s.	
4. Context x Addressee	To Adult Hidden: 1.031 Visible: 1.188	To Child 1.344 1.656	n.s.	n.s.	
5. Addressee x Group			n.s.	n.s.	
6. Context x Group			n.s.	n.s.	
7. Context x Addressee x Group			n.s.	n.s.	

APPENDIX D.5 (cont'd)

b. Matched Words

Effect	Cell Means	F_1	F_2	Min F′
1. Addressee	To Adult: 1.172 To Child: .953	4.52 (1,24) p<.05	n.s.	
2. Context	Hidden : 1.000 Visible: 1.125	n.s.	n.s.	
3. Group	1: 0.813 5: 0.625 2: 1.250 6: 1.000 3: 0.500 7: 1.688 4: 1.652 8: 1.000	3.94 (7,24) p<.01	n.s.	
4. Context x Addressee	To Adult / To Child Hidden : 1.188 / 0.813 Visible: 1.156 / 1.094	n.s.	n.s.	
5. Context x Group		n.s.	n.s.	
6. Addressee x Group	To Adult / To Child 1: 1.250 / 0.375 2: 1.625 / 0.875 3: 0.375 / 0.625 4: 1.625 / 1.625 5: 0.250 / 1.000 6: 1.375 / 0.625 7: 2.000 / 1.375 8: 0.875 / 1.125	4.37 (7,24) p<.005	n.s.	
7: Context x Addressee x Group		n.s.	2.58 (7,32) p=.031	

APPENDIX E.1

In connection with an experiment on the intelligibility of certain words, we need your estimate of when in your life you probably learned each of a series of words, that is, first learned the word and its meaning, either in spoken or written form.
We would be very grateful if you could make estimates for the following words, all of which are concrete nouns. To do this, please list next to each word the appropriate code number from the following scale.

Age	Code
2 and under	1
3	2
4	3
5	4
6	5
7,8	6
9,10	7
11,12	8
13+	9

APPENDIX E.2

Word	Code	Word	Code
1. wheel		37. trousers	
2. brick		38. cushion	
3. book		39. mane	
4. box		40. card (playing card)	
5. bus		41. bear	
6. door		42. carpet	
7. doll		43. tiger	
8. puzzle		44. teddy	
9. lion		45. watch	
10. bike		46. dress	
11. sock(s)		47. jumper (jersey)	
12. house		48. orange	
13. bed		49. pants	
14. block		50. dog	
15. key		51. window	
16. paper		52. teapot	
17. car		53. duck	
18. jigsaw		54. money	
19. patio		55. boat	
20. cat		56. plant (garden)	
21. bath		57. elephant	
22. bucket		58. clock	
23. taxi		59. hen	
24. bag		60. cow	
25. nurse		61. bird	
26. bedroom		62. monkey	
27. saucer		63. basket	
28. gate		64. fence	
29. cup		65. stairs	
30. picture		66. flower	
31. ball		67. wall	
32. tree		68. garden	
33. chair		69. zebra	
34. shoe		70. screw	
35. table		71. hammer	
36. piano			